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Intelligence

USAF INTELLIGENCE TARGETING GUIDE

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This pamphlet explains the principles and concepts of targeting. The data included pertains to tactical, operational, and strategic levels of operations. It begins with a discussion of a target and target systems, then describes the information and intelligence required for targeting, the scope and functions of targeting, analytical techniques, battlefield targeting, and legal aspects of targeting. This pamphlet was prepared by the Targeting Division, HQ 497 Intelligence Group, Air Intelligence Agency. To improve future editions of this publication, users are encouraged to submit comments, suggestions, and pertinent material for additions, changes, and deletions. Forward AF Form 847, **Recommendation for Change of Publication**, to: HQ 497IG/INOT, 5113 Leesburg Pike, Suite 600, Falls Church VA 22041-3230. The use of names of any specific commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

SUMMARY OF REVISIONS

This pamphlet is a revision to AFP 200-17, AFP 200-18 Volumes I and II, and updates target intelligence concepts. Time tested target intelligence techniques and procedures have been reincorporated, updated information on doctrinal issues in the intelligence and operations arena has been included, migration automated systems are described where they pertain to targeting, existing chapters were reordered, and two sections added; a chapter on targeting and information warfare and an attachment on the evolution of targeting.

Chapter 1

TARGETING AND THE TARGET

Section 1A—Foreword

1.1. Foreword . Targeting continues to be a core Air Force Intelligence discipline. Air Force targeting is in evolutionary transition to support *Global Engagement* and the Core Competencies of *Information Superiority* and *Precision Engagement.* This means we can no longer think of targeting as just the bridge between operations and intelligence, but instead visualize full interoperability between Information Operators and Combat (flight) Operators. Targeting continues to be the process of recommending to a commander the targets that support the commander's objectives and the best weapons, which can include lethal and non lethal means, to achieve a desired level of damage and effects to those targets. Although often confused with just weaponeering (one of its functions), targeting looks across a range of military capabilities. **NOTE:** Due to the present transition in Air Force Doctrine, especially in terminology, the terms Operations (Ops) and Intelligence have been used to eliminate any confusion.

1.1.1. Air Force targeteers are experienced intelligence personnel trained in the specifics of targeting and knowledgeable about operations. Targeting professionals do not produce intelligence, but instead apply intelligence. In the same vein, they do not direct operations, but provide expertise to the staff to nominate and suggest targeting options for planning and implementation.

1.1.2. This pamphlet is based on concepts in the application of airpower, from an intelligence and operational point of view. In many cases there is no one "best" way to perform targeting. Often the particular process used to arrive at a solution is not as important as the solution itself. Targeting includes more than operations and intelligence--it includes the whole spectrum of military techniques that are used to make the enemy perform our will. It is not a newly discovered concept, but a synthesis of thinking and airpower application over the decades. **Attachment 2** includes a summary of that history..

Section 1B—Preface

1.2. Preface. This pamphlet is intended to be an aid to targeteers from the combat unit to the force management level. It is designed to be the primary source of basic information on Air Force targeting. It describes the principles and some of the techniques of targeting. It is, however, intended to be the USAF's "how-to" manual for targeting.

1.2.1. This pamphlet presents three types of information: basic concepts and definitions, fundamental procedures and techniques, and reference information. Use of this pamphlet may not be in thorough cover-to-cover reading, but in a review, dependent on your experience. The first two chapters are an introduction to targeting and intelligence in general. The first chapter is "must reading" for everyone. The second chapter could be used by experienced intelligence personnel as a refresher. The pamphlet then progresses to more complicated concepts and techniques. Major topics addressed include the targeting process; combat unit level functions; target value analysis and assignment of priorities; analysis, both quantitative and qualitative; target materials and target location; special targeting problems, such as information warfare; and international law as applied to targeting.

1.2.2. This pamphlet is the result of work by many people and is an evolutionary product of much effort, past and present. Since it is a "how-to" document we have included some "Foot Stompers" that are intended to illustrate real experiences distilled to short narratives. Such illustrative narratives may not always represent current official policy or views. The project has drawn from many sources for examples of quantitative analysis. With their targeting expertise, continuity, and their long-term view, Air Force Reserve personnel have made outstanding contributions to this pamphlet. Future revisions of this document will depend on similar support by all targeting personnel.

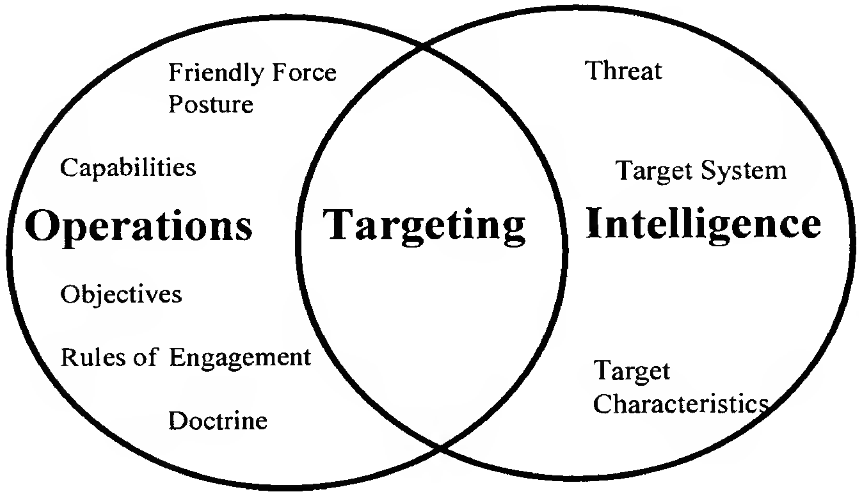
Section 1C—Fundamentals of Targeting

1.3. Overview . This chapter outlines some fundamentals of targeting and the target intelligence process. It also examines the strike or attack mission cycle, with emphasis on targeting activities. It examines targets as independent entities and as components of target systems. It discusses target system characteristics and describes the scope and position of the targeting function at the crossroads of intelligence and operations (figure 1.1).

1.4. Targeting . Targeting recommends the best means to attain a goal. It integrates intelligence information about the threat, the target system, and target characteristics with operations data on friendly force posture, capabilities, weapons effects, objectives, rules of engagement, and doctrine. Targeting matches objectives and guidance with inputs from intelligence and operations to identify the forces necessary to achieve the objectives. It spans not only nuclear, conventional, chemical, and non lethal force application, but can also include information warfare, space, and special operations in joint and combined operations. From this integration, targeting makes recommendations for the use of aerospace forces. Joint Pub (JP) 1-02, *DoD Dictionary of Military and Associated Terms*, defines targeting as "(1) The process of selecting targets and matching the appropriate response to them, taking account of operational requirements and capabilities; (2) The analysis of enemy situations relative to the commander's mission, objectives, and capabilities at the commander's disposal, to identify and nominate specific vulnerabilities that, if exploited, will accomplish the commander's purpose through delaying, disrupting, disabling, or destroying enemy forces or resources critical to the enemy." The exploitation of information, although not mentioned in the joint definition, is also of great importance.

1.5. The Targeting Process. The Air Force targeting function cuts across traditional functional and organizational boundaries. Operations and intelligence are the **primary** active participants, but other functional areas such as logistics and communications also support the targeting process. Close coordination, cooperation, and communication among the participants are essential for the best use of resources.

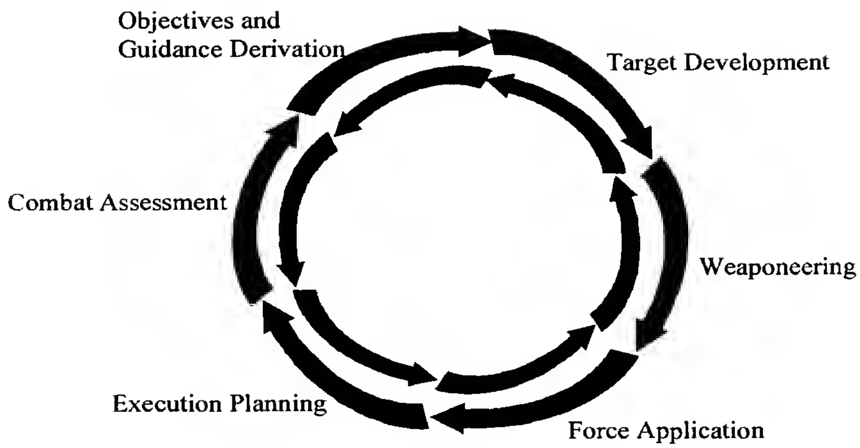
Figure 1.1. Targeting--The Intersection of Operations and Intelligence.



1.5.1. The targeting process is an analytical, systematic approach that focuses targeting efforts on supporting operational planning and facilitates force employment. A model has been constructed that centers around six phases considered the framework for the targeting process (figure 1.2). This chapter will briefly describe each step in this theoretical construct; later chapters will describe the specifics involved in each step. The six steps of the targeting process are:

- Objectives and guidance derivation
- Target development
- Weaponeering
- Force application
- Execution planning
- Combat assessment

Figure 1.2. The Targeting Process.



1.5.2. Although the Targeting Process shows the phases to be sequential, in reality, the process is bi-directional and iterative. Additionally, targeteers often perform several of the phases simultaneously. Successful accomplishment of the targeting process requires diverse informational inputs. These inputs include intelligence on the enemy's defensive and offensive posture, capabilities, and intentions; intelligence on enemy targets and target system characteristics; friendly force posture and capabilities; concepts of operations; mission objectives; rules of engagement; and time and perishability constraints. In general, there are four end products of this process:

- Target nomination lists
- Weapon and weapon system recommendations
- Supporting target materials
- Assessment criteria for evaluating the operation

1.5.3. Targeting Process Phases.

1.5.3.1. Objectives and Guidance Derivation . Objectives and guidance are the foundation of the targeting process. In this phase, the objectives and guidance are developed and disseminated to the targeteer. Objectives are developed at the national, theater, and component levels. Guidance is generally provided at the National and war fighting CINC-level. Both objectives and guidance must be quantifiable and unambiguous in order to be effective.

1.5.3.2. Target Development. This is the examination of potential target systems and their components to determine change to system criticality and vulnerability to attack. This phase distills the commander's objectives into lists of targets. The product of this phase is a suggested target list with recommended priorities assigned and extent of desired damage.

1.5.3.3. Weaponeering Assessment. In this part of the process, planners assess the types and quantity of weapons estimated to achieve a desired level of damage to the individual targets. The product of this phase is a list of recommended weapons and aircraft for each target and a validated list of weapon impact points for each target. Weaponeering takes into account target vulnerabilities, weapons effects and reliability, delivery accuracy, delivery conditions, as well as damage criteria.

1.5.3.4. Force Application. The force application phase uses the information generated in the target development and weaponeering assessment phases to determine the best force necessary to meet operational objectives. At this point, the decision maker is provided with fused intelligence on the target and weapon systems recommendations. It is here that operations and intelligence merge their planning efforts to meet the CINC's guidance.

1.5.3.5. Execution Planning. Execution planning prepares input for and supports the actual tasking, construction, and subsequent execution by weapon systems. Input includes data concerning the target, weaponeering calculations, employment parameters, and tactics. The operational command is responsible for monitoring the ATO/ITO, making any changes necessary and providing support to the units. Under Air Force doctrine of centralized control, decentralized execution, unit commanders are given the freedom and flexibility to execute the plan, as they see fit.

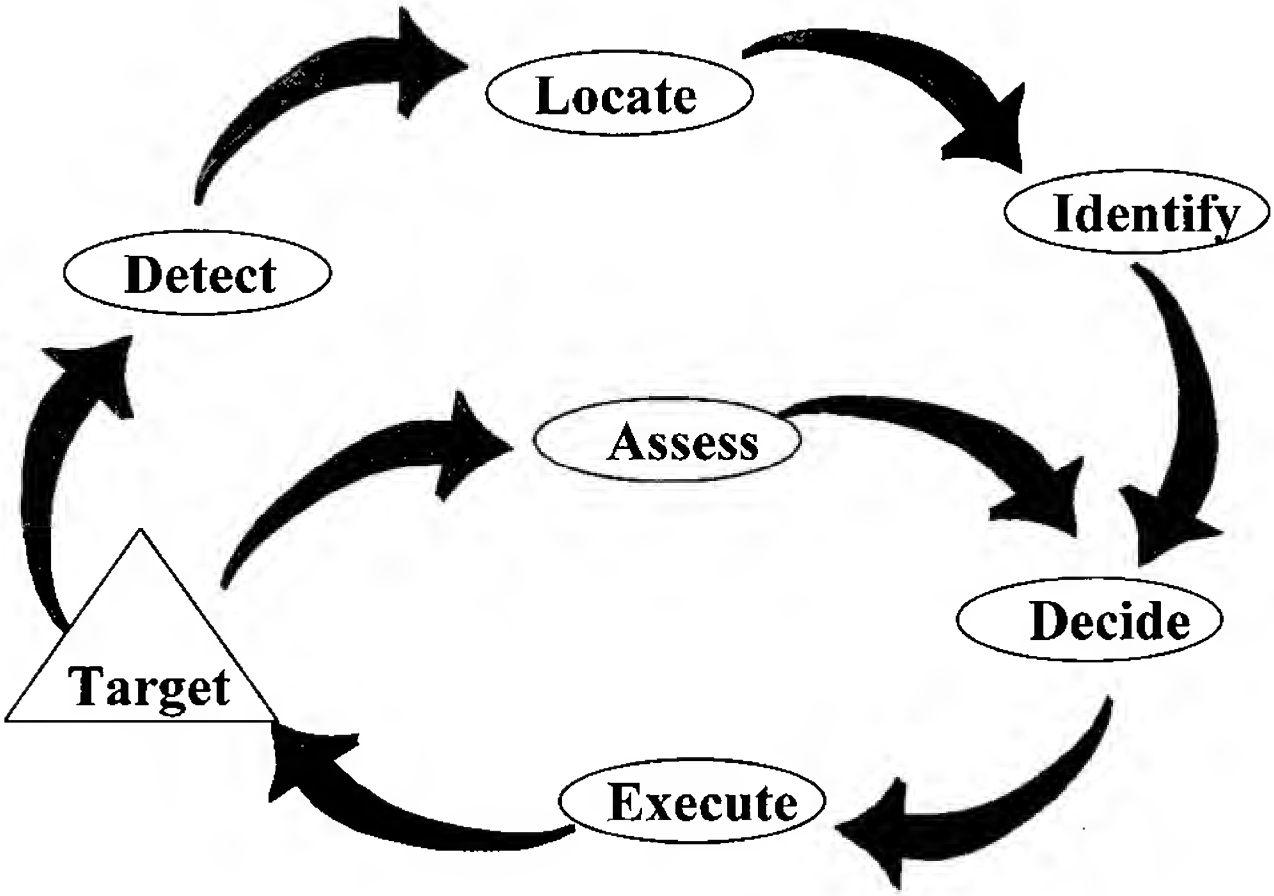
1.5.3.6. Combat Assessment. After mission execution, the quality of the whole process is assessed. Improvements in force employment, munitions design and situation assessments emerge from this appraisal of post-strike data. The results of this effort affect future combat operations and can change theater objectives. The product of this phase is tailored to the decision makers.

1.6. Strike or Attack Mission Cycle Functions and Targeting.

1.6.1. Targeting plays a key role in the commander's decision to employ attack forces; this decision making process in the operations community is frequently referred to as the attack mission cycle or the strike/attack cycle. JP 1-02 defines mission cycle "as it pertains to targeting, is a decision making process used by commanders to employ forces." This cycle is similar to the targeting process and is sometimes confused with the targeting or ATO cycle.

1.6.2. Within the attack mission cycle, there are six general steps: detection, location, identification, decision, execution, and assessment (figure 1.3). For the initial attack, the outer cycle (detection, location, identification, decision, and execution) is used. After the initial attack, both cycles run at the same time and interact through analysis at the decision step.

Figure 1.3. Attack or Mission Cycle Functions. The six mission funchtions of the cycle interact continuously at the decision stage where target analysis.



1.6.3. The attack cycle works on four assumptions.

- There must be direction and guidance provided for each of the six steps.
- There must be a collection program and data base construction and maintenance before target detection.
- The cycles do not occur in isolation; the situation greatly affects the cycles.
- The time to complete one entire cycle may vary from minutes to weeks, and any function in a cycle may be performed by a combination of human and/or machine.

1.6.4. While the point of understanding the cycle is not to see how fast the functions can be performed, the functions must be performed quickly enough to use the information developed, that is, the intelligence developed during the attack cycle must arrive in time to influence the decision and execution, either in a positive or negative sense. This concept, “fast enough for the intended purpose, "is termed “in time” in this handbook.

1.6.5. Relatively short cycles must be accommodated by the functions. The time span between the detection of a potential target and the execution is termed the attack cycle time budget.

1.7. The Target. The term *target* has several meanings and is used in various contexts. Joint Publication (JP)

1-02 defines a target as: "a geographic area, complex, or installation planned for capture or destruction by military forces." The intelligence community definition is "a country, area, installation, agency, or person against which intelligence operations are directed." For targeting purposes, this definition must be expanded to include the contents of the area, complex, or installation (e.g., people, equipment, and, resources). Furthermore, capture or destruction must be expanded to include disruption, degradation, neutralization, and exploitation, commensurate with objectives and guidance.

1.7.1. Relationship to the Objective. A target must qualify as a military objective before it can become a legitimate object of military attack. In this context, military objectives include those objects that by their nature, location, purpose, or use make an effective contribution to military action, or whose total or partial destruction, capture, or neutralization offers a definite military advantage. The key factor is whether the object contributes to the enemy's war fighting or war sustaining capability. Consequently, an identifiable military benefit or advantage should derive from the degradation, neutralization, destruction, capture, or disruption of the object. Not only does this concept preclude violations of the Law of Armed Conflict (LOAC), but it also supports the principles of war by employing economy of force against valid military objectives.

1.7.2. Target Types. Targets may be classified in many fashions, but usually are grouped by the broad mission assigned or their target system. Generally, missions follow doctrine in areas such as Interdiction, Counterair, Strategic Attack, or Maritime Control. Some targets can impact two or more areas. Targets can affect the spectrum of military operations and, in any set of scenarios, the same target could be tactical, operational, or strategic. Whether a target is classified as operational or strategic is not always as important as the results attained. The difficulty of classification flows from the definitions of the terms and relevance of the target to the war fighting effort. According to AFDD 1-1, the strategic level of war incorporates the broadest concerns of national policy. Operational level focuses on campaigns and major operations that guide tactical events. Tactical level focuses on battles and engagements. Geographical areas, operating environments, delivery vehicles, and munitions DO NOT dictate the classification of a target as strategic, operational, or tactical.

1.7.3. Fixed Target Identification Data. Because of the great amount of intelligence available, large numbers of potential targets, and a variety of data bases, it is essential to have a standard reference system. Fixed targets are listed, described, and indexed through five basic elements of information, they are: the basic encyclopedia (BE) number, the functional classification code, the target name, the geographic coordinate, and a two-character geopolitical (or country) code. (Refer to the *Target Intelligence Handbook* [TIHB] [DDB-2600-312-YR]).

1.7.3.1. Basic Encyclopedia (BE) Numbers (BEN). The ten-character BE number has two parts: the World Aeronautical Chart (WAC) number, which consists of four characters; and the installation number, which consists of either six numeric characters, one alpha and five numeric characters, or two alpha and four numeric characters. A BE number may be used as follows:

1.7.3.1.1. Standard BE numbers. Most installations in the Automated Installation Intelligence File have a BE number with a zero in the fifth character-position. Standard BE numbers are assigned sequentially by the producer. The exceptions are airfields and electronic sites.

1.7.3.1.2. Non-DIA Produced BE Numbers. An installation discovered by non-DIA elements and reported for inclusion in the Modernized Integrated Data Base (MIDB) is identified by a BE number that carries alpha characters in the fifth and sixth character positions. These characters represent the exploitation element that assigned the number and controls it.

1.7.3.1.3. Electronic BE Numbers. The BE numbers for a non-communication electronic installation consists of the WAC number, with an "E" in the fifth character position, and a five-digit EOB site number.

1.7.3.1.4. Fictitious BE Numbers. The BE number for a fictitious (projected) installation has an "F" in the fifth character position. This is useful for exercise databases or for unclassified exercise scenarios.

1.7.3.2. Functional Classification Codes. Each installation is classified or categorized to reflect products and military activity supported, etc. They are categorized by a five-digit code, as follows:

1.7.3.2.1. The first digit gives the function in nine major categories. The other four digits show functions within the group. From left to right, each one describes the function or capability of the installation more specifically. A code is assigned to each fixed facility that has some significance. The functional code for a mobile system (e.g., SAM, AAA, GCI, etc.) is assigned to the specific area that the system supports or where the activity is located (rather than the equipment itself). See DIAM 65-3-1 for these functional classification codes, commonly known as category codes.

EXAMPLE: 80052 Airfield, fighter base, primary mission is support of ground attack aircraft.

1.7.3.3. Installation Names. Because of the many types of installations, coupled with the various name forms and component parts, a specific procedure is used to select and apply installation names. There are seven name components used to identify installations. These components appear in the following order: place name, functional name, distinguishing descriptive terms, proper name, honorary name, underground designation, and installation alpha or numerical designators. However, not all of these names may appear on one installation. (For standard abbreviations and procedures used, see the *Target Intelligence Handbook.*) CIA and some other sources of installation name do not always use the standard DoD naming scheme; be careful in trying to correlate installations based only on the name. The same applies to place names

1.7.3.4. Installation Coordinates. Latitude and longitude coordinates represent the fourth standard element for installation identification. They are reference coordinates only and they are selected by approximating the center of mass for an installation. For airfields, the center of the runway or intersection of major runways is selected. Fields in the MIDB will indicate the source of coordinates (See DDB-2600-725-XX, *Point Reference Guide Book*).

EXAMPLE: 265134N0932402E

1.7.3.5. Geopolitical codes. Geopolitical or country codes are composed of two alpha characters listed in the *Target Intelligence Handbook.* These codes are used in every installation record as one of the basic identification elements.

1.7.3.6. Installation Reference Numbers And Target Complexing. These target complexing methodologies are further explained in the *Target Intelligence Handbook.*

1.7.4. Target Characteristics. Every target has distinct inherent, acquired, functional, physical, environmental and mobility characteristics (**Table 1.1.**). The target characteristics form the basis for target detection, location, identification, and classification for future surveillance, analysis, and strike.

1.7.4.1. Inherent Characteristics. Inherent characteristics are the initial, original, designed, or essential characteristics of an object or area. Generally, these are immediately obvious features and are used to detect, identify, and categorize an object or area. Inherent target characteristics include, for example, the expansive and relatively level area that is free from surrounding vertical obstructions at airfields; barracks, tents, administration buildings, service buildings, and perimeter fences at military installations; and the spans, piers, abutments, and superstructures of bridges. Generally, these characteristics consist of those gross and usually obvious features that are used (either consciously or unconsciously) in detecting, identifying, and categorizing an object or area.

1.7.4.2. Acquired Characteristics . Characteristics that modify, enhance, or augment the inherent characteristics of an object or area are acquired characteristics. Examples include: replacing a sod runway with a concrete runway; building a surface-to-air missile (SAM) site within the perimeter of a previously undefended troop concentration area; and widening the deck of a one-lane highway bridge to two lanes. Acquired characteristics can change a target's function without necessarily modifying its observable characteristics. For example, a fertilizer plant might be converted to an explosives production facility without changing the outside appearance of the plant. Because the characteristics of all objects and areas are changeable, each target must be routinely monitored to ensure that any status related changes are brought to the attention of target analysts.

1.7.4.3. Functional Characteristics . These characteristics describe operations and activity levels of an actual or potential target and are extremely important in determining target value. Functional characteristics are often hard to determine because of difficulties in directly observing or investigating the target. In these cases, analysts must use other data collection activities to supply the necessary information. Reaching a plausible conclusion can involve considerable speculation and deductive or inductive reasoning. Functional characteristics include target function, status, level of activity, functional complexity, importance, reconstitution potential, and position. Functional characteristics contain the following:

- Function (target's normal or reported activity)
- Status (state or condition at a given point in time)

Operational (producing or capable of action, i.e., is manned, has equipment, and is mission ready, even if damaged to some extent)

- Occupied (has equipment, but cannot be determined if manned or operational)
- Transitional (passing from one condition, form, stage, or place, to another)
- Nonoperational (not producing or inactive)
- Dormant (inoperative or inactive)
- Damaged
- Dismantled
- Level of activity

- High
- Normal
- Low
- Functional complexity (the number and complexity of separate activities)
- Material and psychological importance (actual or perceived value or significance)
- Horizontal (within a given level or echelon)
- Vertical (up or down the organizational hierarchy)
- Reconstitution potential (capable of recovering from damage so as to perform its functions)

1.7.4.3.1. Level of activity is an important functional characteristic when considered in relation to the entire scenario and when compared to other similar targets. Functional complexity is the number of separate activities that make up a target and the complexity of each. Importance is the value or significance of a target in either a material or psychological sense as it relates to other similar targets, to the organizational hierarchy, and to the current scenario. Reconstitution potential is a target's capability to recover from damage to perform its original function. Position is a target's relational location within the military or governmental organizational structure.

1.7.4.4. Physical Characteristics . Physical characteristics are the visually discernible features or the target's sensor derived signatures (detected, identified, and categorized displays registered in one or more portions of the electromagnetic spectrum). The target shape, size, composition, reflectivity and radiation propagation, determine to a large extent, the type and number of weapons, weapon systems, or sensors needed to accomplish the attack or intelligence objective. Physical characteristics of the target are described using words, abbreviations, acronyms, or numbers (for example, shape, dimensions, type of construction, etc.). They include the following:

- Size and shape
- Point target (the target equals the aimpoint; it is encompassed in a small area with respect to the attacking or

striking systems, delivery accuracy, and munitions effects)

- Area target (a large area usually composed of multiple elements or components)
- Linear target (long and narrow)
- Appearance (outward form and features)
- Physical complexity
- Dispersion and concentration of elements
- Number of components
- Personnel
- Redundancy
- Substance (construction materials or matter used in structures in any object or area)
- Reflectivity potential (the ability to reflect light, heat, or sound)

- Electromagnetic radiation propagation (the emission or transmission of wave energy; gamma radiation; x-rays;

visible, infrared, and ultra-violet radiation; and radar and radio transmissions)

- Active (intentional emission propagation)
- Passive (unintentional emission propagation)
- Vulnerability (susceptibility to damage, destruction, or functional disruption as a result of military action)
- Hard (low sensitivity to damage or disruption)
- Soft (high sensitivity to damage or disruption)
- Reconstitution potential (capable of recovery from damage so as to perform its original functions)

1.7.4.5. Mobility Characteristics. Mobility characteristics are a target's ability to move or be moved. A target's mobility is closely related to its functional and physical characteristics and is influenced by prevailing doctrines or strategies governing its use. Mobility characteristics include whether a target is moving or nonmoving. A nonmoving target is one that is either temporarily or permanently stationary. These can be classified further as being:

- Fixed. Immovable objects (e.g., an airfield)
- Mobile. Targets capable of moving under their own power
- Transportable. Targets capable of being transported or relocated

1.7.4.6. Environmental Characteristics. These are relatively constant or manmade conditions and circumstances within which the target exists. These characteristics affect decisions concerning reconnaissance and weapon system selection and employment. They include:

- Atmospheric characteristics, such as the current and forecasted weather conditions
- Temperature
- Weather (light, moderate, or heavy thunderstorms, rain, drizzle, hail, snow, ice, etc.)
- Visibility (clear, obscured by smoke/fog/haze/blowing dust/blowing sand/blowing snow/ blowing spray)
- Cloud cover (percentage of ground obscured by clouds at various altitudes above the target)
- Winds (direction and intensity at various altitudes)
- Atmospheric pressure
- Light
- Physical relationships
- Target density (number of elements per unit of area; target compactness; proximity to other targets)
- Relation to allies, friendlies, or enemy civilians (distance and direction). Forward Line Own Troops (FLOT)
- Geographic characteristics:

- Terrain (type or description of land forms; that is, plains, hills, plateaus, or mountains)
- Vegetation (density and heights of tree coverage, undergrowth, and grass)
- Geology (composition, water content, and density)
- Elevation (above mean sea level)
- Waterways (rivers, streams, canals)
- Cultural features (cities, roads, rail lines, power lines, etc.)
- Economic characteristics, including the availability of raw materials, personnel, energy, water, and transportation
- Raw materials
- Personnel support (shelter, life support)
- Energy (sources)
- Water (potable or nonpotable)
- Command, control, and communications
- Transportation support
- Enemy countermeasures
- Electronic countermeasures (ECM) and electronic counter-countermeasures (ECCM)
- Defenses (AAA, SAMs, aircraft, etc.)
- Concealment (caves, trees, etc.)
- Deception efforts (dummy SAM sites, dummy aircraft, etc.)
- Camouflage (nets, paint, etc.)

NOTE:
The characteristics of all objects and areas are changeable. Each target must be monitored routinely to ensure any status related change is brought to the attention of target analysts.

Table 1.1. Target Characteristics.

Functional Characteristics	Environmental Characteristics
• Function	• Atmospheric conditions
• Status	• Temperature
• Operational	• Weather
• Occupied	• Visibility
• Transitional	• Cloud cover
• Nonoperational	• Winds
• Dormant	• Atmospheric pressure
• Damaged	• Light
• Dismantled	• Physical relationships
• Level of activity	• Target density

• High	• Relation to allies, friendlies, or enemy civilians
• Normal	• Geographic characteristics:
• Low	• Terrain
• Functional complexity	• Vegetation
• Material and psychological importance	• Geology
• Horizontal	• Elevation
• Vertical	• Waterways
• Reconstitution potential	• Cultural features
	• Economic characteristics
Physical Characteristics	• Raw materials
• Size and shape	• Personnel support
• Point target	• Energy
• Area target	• Water
• Linear target	• Command, control, and communications
• Appearance	• Transportation support
• Physical complexity	• Enemy countermeasures
• Dispersion and concentration of elements	• ECM and ECCM
• Number of components	• Defenses
• Personnel	• Concealment
• Redundancy	• Deception efforts
• Substance	• Camouflage
• Reflectivity potential	
• Electromagnetic radiation propagation	**Mobility Characteristics**
• Active	• Fixed
• Passive	• Mobile
• Vulnerability	• Transportable
• Hard	
• Soft	
• Reconstitution potential	

1.8. The Target System Concept. The target system concept is important because almost all targeting is based on targeting systems. A target is composed of components, and components are composed of elements. A single target may be significant because of its own characteristics, but often its importance lies in its relationship to other targets. Usually the effect of a strike or attack mission upon an enemy can be determined only by analyzing the target in the overall enemy's target system. JP 1-02 states that a "target system" includes "(1) All the targets situated in a particular geographic area and functionally related; (2) A group of targets which are so related that their destruction will produce some particular effect desired by the attacker". Targeteers normally focus on functionality. "Functionally related" means that all targets in the system have the same activity, or that each makes one or more parts of a particular product or type of product. Usually the effect of an attack upon an enemy can be determined only by analyzing the enemy's target systems and their relationship(s) with the enemy's warmaking or warfighting capability.

1.8.1. Target System Characteristics. All target systems have certain general characteristics:

- Survival is fundamental for all systems.
- All systems adapt to survive.
- Systems are goal, objective, or purpose oriented.
- Systems are composed of individual parts called components.
- Each system is a component of a larger, more inclusive system.
- Through its components, the system performs activities to achieve its goals.
- Systems are complex. System components are interdependent, so that a change in one component causes change in or to other components.

1.8.2. Target System Components . JP 1-02 defines "target system components" as "a set of targets belonging to one or more groups of industries and basic utilities required to produce component parts of an end product." This definition covers the basic concept of the relationship between a target system and its component parts. It does not, however, define the whole series of target components. A target system is divided into components, each of which may be a target. A system component is an entity supporting a functional process to produce an end product or service. For example, an air defense system may include command and control, early warning and target acquisition radars, antiaircraft artillery (AAA) and surface-to-air missile (SAM) batteries, SAM support facilities, and other components that are neither industries nor utilities.

1.8.3. Target System Activity . The targeting process should not focus on the system or its components, per se, but on the activity of the system or its components. By determining which activity is to be modified or affected by friendly forces, key target systems and target system components can be identified and nominated for strike. On a lesser scale, this same analysis can be performed for individual targets. Key and vulnerable elements of each target can be identified for attack. A comprehensive analysis of the system and its component parts is essential to understand the activities of the entire system.

1.8.4. Target System Elements . Target system elements are smaller, more intricate parts of the target system than component and are necessary to the operation of the component as a whole.

Chapter 2

INFORMATION AND INTELLIGENCE

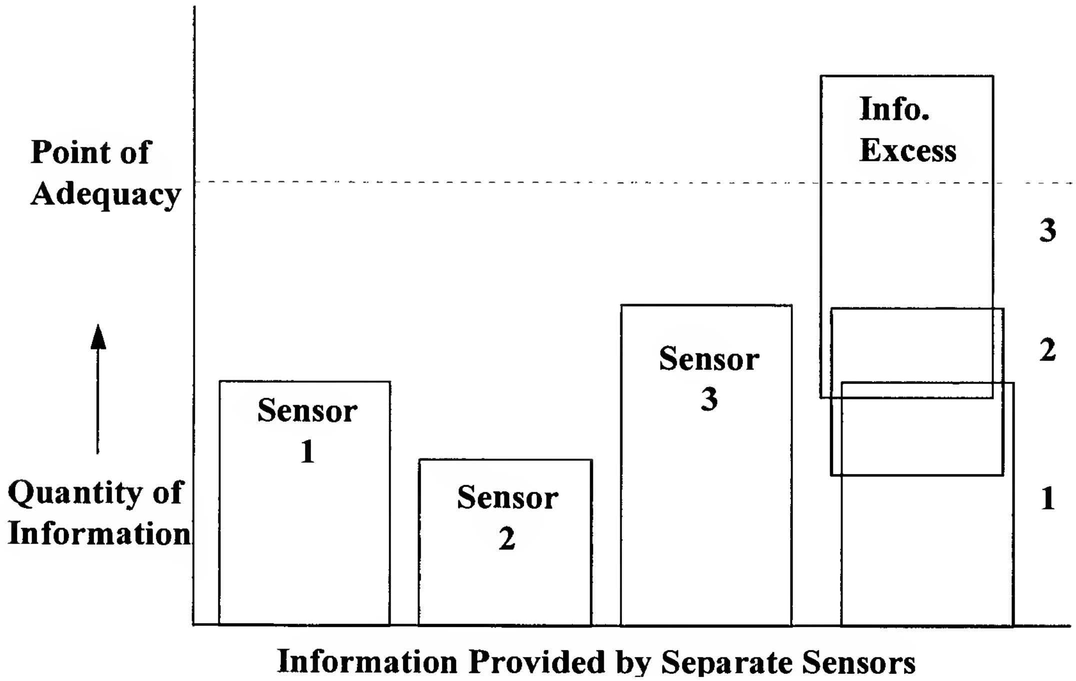
2.1. Information as a Resource. Information is one of the most precious resources available to any decision maker. By nature, humans are information processors who seek knowledge of the past, present, and prospects for the future. Without valid information, decision makers have no logical basis for choosing one course of action over another. Increasing information generally decreases uncertainty in decision making, up to a point of diminishing returns, where too much information can confuse a situation. In a sense, information is like fire insurance. It has little value until it is needed, but then it is invaluable.

2.1.1. Sources of Information. Information can take many forms and be derived from many sources. Information can result from observing or reporting an event. It can be derived from the manipulation of facts through computation. It can also result from professional opinions, judgments, and interpretations by participants. Information may be objective or subjective. Usually, it comes from a combination of sources and is a presentation of both fact and insight.

2.1.2. Characteristics of Information. Information has many characteristics and does not come without cost. Acquiring sufficient, accurate, and timely information can be very expensive. It can be perishable and is generally imperfect. Consequently, information from one source should be verified with another source whenever possible. Frequently, information derived from one source can be used as a cue in researching other sources or in collecting additional or different information. Information can be acquired through various methods. Each has advantages, and all have inherent and environmental limitations and constraints. The observer, as a source of information, is often biased. Observers are also limited by what can be seen. Since it is difficult to observe an elaborate and dynamic system, the tendency is to "freeze" the situation and examine individual system parts in a static state. In doing so, essential ingredients are frequently lost. There is often the danger of attributing a great degree of precision to imperfect assessments or measurements. Because of these many limitations, information varies in validity and reliability.

2.1.3. Information Threshold. The information threshold is that point in time when one has accumulated enough information to make a valid decision. In theory, one should keep collecting information until the information threshold or the point of adequacy is reached. As figure 2.1 suggests, independent information sources 1, 2, and 3 do not provide sufficient information to reach the threshold. But when information from all three sources is combined, the threshold is reached and the point of diminishing returns (that is, when the additional information costs more to collect than the value gained from having it) is reached. Keep in mind that the point of adequacy for information is adjustable depending on the fidelity of information needed. If the various portions are viewed as an "information budget", the information threshold and collection resources can be managed accordingly.

Figure 2.1. Information Accumulation. The combination of several sources of information enables an analyst to make a valid decisions with reasonable certainty. Information collected beyond the point of dimishing returns is excessive, costing more to collect than it is worth.



2.1.4. Intelligence Processing. Since information does not present itself for exploitation, it must be sought, gathered, assembled, and processed into usable form. The outcome is the transformation of raw information into intelligence suitable for making valid decisions. There are three levels of intelligence support: strategic, operational, and tactical. Strategic intelligence is required for the formulation of strategy, policy, and military plans and operations at national and theater levels. Operational intelligence is required for planning and conducting campaigns and major operations to accomplish objectives within theaters or areas of operations. Tactical intelligence is required for planning and conducting tactical operations. Intelligence sources are the means or systems used to observe, sense and record, or convey information. There are seven primary intelligence source types: imagery, human, signals, measurement and signature, open source, technical, and counterintelligence.

2.1.5. The Intelligence Cycle. As stated in JP 1-02, the intelligence cycle is defined as "the steps by which information is converted into intelligence and made available to users". The five steps in the cycle are:

- Planning and direction--determination of intelligence requirements, preparation of a collection plan, issuance of orders and requests to information collection agencies, and a continuous check on the productivity of collection agencies.
- Collection--acquisition of information and the provision of this information to processing and/or production elements.

- Processing--conversion of collected information into a form suitable to the production of intelligence.
- Production--conversion of information into intelligence through the integration, analysis, evaluation, and interpretation of all source data and the preparation of intelligence products in support of known or anticipated user requirements.
- Dissemination--conveyance of intelligence to users in a suitable form. A more complete description and further explanations can be found in JP 2-0, Joint Doctrine for Intelligence Support to Operations.

2.2. The Fusion Principle.

2.2.1. Fusion. The process of combining multisource data into intelligence necessary for decision making is called fusion. Due to the limitations inherent in any collection system, and because other countries strive to misinform or deny information to intelligence gathering agencies, intelligence normally should not be based on single source data. Intelligence becomes more useful and more reliable when information from all possible sources is collected, combined, evaluated, and analyzed in a timely manner.

2.2.2. Accuracy and Timeliness. Fusion of multisource data adds credibility to intelligence estimates. Given the vast quantity of material collected and the rapid pace of modern warfare, the fusion process should be automated whenever possible and its products made readily available to all levels of command. Fusion facilitates accuracy. Accuracy and timeliness should be a constant goal of all targeting personnel.

2.2.3. Application of Fusion. Fusion is not always possible, but the principle should be used whenever possible to enhance intelligence support without degrading the timeliness of that support. There are times when information from one source cannot be confirmed by others or is highly perishable. Factual and important single source information should be disseminated immediately. Follow-on data should be presented when it becomes available.

2.2.4. Organizational Structure. Organizational structure can aid both the fusion process and the flow of useful intelligence. Effective staff structuring, coordination, and cooperation are imperative if the commander's intelligence needs are to be met.

2.3. Hierarchy of Intelligence Products. Intelligence production and fusion can also be viewed through a hierarchy of products. There are five categories in intelligence production, with each one a building block. They are: raw or unevaluated data; processed data; analyzed basic data reports; integrated intelligence; and intelligence end products. Through fusion, improved products are built from those lower in the hierarchy.

2.3.1. Raw or Unevaluated Data. This is the basic building block from which all intelligence products are derived. It includes unexploited film from reconnaissance missions, untranslated messages from intercepted communications, recordings of foreign radar signals, and all other types of raw data.

2.3.2. Processed Data. The second level in the hierarchy is made up of materials that have been refined to a stage where they can be analyzed. This can include initial imagery interpretation reports, translation of captured documents, and preliminary reports based on intercepts of foreign radar signals. This data is produced by agencies such as imagery interpretation facilities, human intelligence (HUMINT) detachments, and electronic reconnaissance processing elements. The Contingency Airborne Reconnaissance System (CARS) is one example where two "Ints" from a single platform are processed, and the synergistic effect enhances the processing.

2.3.3. Analyzed Basic Data Reports. At this level of the hierarchy, intelligence products from similar sources are compared and collated, but there is no attempt to fuse intelligence from these sources. For example, all imagery interpretation reports on a single installation may be collated, or translated message traffic from two foreign army units may be compared. Basic data reports are used to form a data base and result from a collation process oriented toward individual weapon systems, installations, or types of material.

2.3.4. Integrated Intelligence. These products result from detailed analysis and fusion of multiple intelligence sources. Examples include orders of battle, scientific and technical reports, intelligence estimates of foreign power capabilities and intentions, and the installation and orders of battle data in the MIDB. Integrated intelligence is usually produced at Joint Intelligence Centers (JIC) and by the national intelligence community. DIA, Unified Commands, the Central Intelligence Agency (CIA), and the National Security Agency (NSA) are all major producers. Integrated intelligence products are, in turn, used to produce other intelligence products.

2.3.5. Intelligence Products. This category includes materials intended for dissemination to users. End products result from additional analysis, evaluation, and fusion of materials produced at lower levels in the hierarchy. These products are probably the most important, and when available are the best source on which to base force employment decisions. Electronic versions are available through INTELINK and SIPRNET. Newer information technology now allows links between intelligence producers. The Air Force Information Warfare Center's (AFIWC) SENSOR HARVEST is an example.

2.4. Prerequisite Information and Intelligence for Targeting. To begin target planning the following information requirements should be addressed to prevent waste of resources.

2.4.1. Intelligence on Enemy Defensive and Offensive Posture, Capabilities, and Intentions. The targeteer must have current, accurate intelligence on the enemy's status and predisposition.

2.4.2. Target System, Component, and Element Characteristics. Targeteers must have current, accurate intelligence on the physical, functional, mobility, and environmental characteristics of potential enemy targets.

2.4.3. Friendly Force Posture and Capabilities. The targeteer should know what forces will be available for offensive operations and the capabilities of these forces. Care must be taken to prevent potential options from being overlooked because a capability is assumed not to be available. If a force capability not available at the beginning of an analysis can be demonstrated to be clearly superior, it may be possible to obtain the capability. In any event, targeting personnel should be aware of current and potential force capabilities and consider them during their analysis.

2.4.4. Concept of Operations, Mission Objectives, and Rules of Engagement. The targeteer must understand the concept of operations and mission objectives in order to conduct an analysis that results in target recommendations to achieve those objectives. They should remember that most offensive operations take place in a joint service environment. Consequently, the scheme of maneuver of other component forces should be known to make all systems effective, and the operation of the USAF component should be integrated as much as possible with them. Even though the Unified commander is responsible for integrating operations by the various service components, this can only happen in fact if the effort is made at the working level, during the basic planning.

2.4.4.1. For targeteers to function effectively, they must understand Air Force and Joint doctrine. Doctrine is important because it is based on the capabilities of the US military and states fundamental concepts upon which planning should be based.

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Doctrine is even more important than a planner might initially think. JCS and the Commands use a complex, but well documented, Deliberate Planning Process to construct and update Operations and Concept Plans. In the fast breaking crisis environment of world media attention, these procedures are pared down to Crisis Action Planning. The deliberate and iterative process of what the nation needs to effect and what it wants the new enemy to do is often lost to what the various agencies, services, and commands can do. Doctrine is still more important when faced with unclear, or still forming, objectives and guidance. The targeteer must help formulate objectives and guidance. Knowledge of interdiction (JP 3-03) or C3CM (JP 3-13) provides a solid basis for good planning.

2.4.4.2. Another prerequisite for target analysis is a general knowledge and understanding of the tactics that will probably be employed during actual operations. Specific operational restrictions must also be considered. These may consist of international law limitations, rules of engagement (ROE), area closures because of operations, or restrictions laid down by commanders or foreign governments.

2.4.4.3. Targeteers must also be able to perform analysis that could lead to policy changes, such as a lifting of certain ROEs. The ROE can be changed, but this rarely occurs unless higher authorities are made aware of a requirement for a change. The effects of such restrictions can and must be clearly stated to the commander so action can be taken to change them.

2.4.5. Time Constraints. Time is a critical commodity and must be managed skillfully. The targeteer must have the right information in time to assist the decision maker.

2.4.5.1. The response time for providing support varies with each of the categories of missions identified in ACCI 13, *Air Operations Center, Volume 3.* Preplanned missions are those for which a requirement can be foreseen, permitting detailed planning and coordination. Immediate missions are those for which specific target makeup and location cannot be determined in advance.

2.4.5.2. The six functions of the strike or attack mission cycle are performed for both preplanned and immediate missions. The entire cycle may take from seconds to weeks, and targeteers must be responsive to the time requirements of this cycle. Rapid decision making is essential for immediate mission support. If targeteers cannot provide timely support to the commander, they are likely to be ignored in future decision making. Locating those analysts close to the decision makers can increase responsiveness. The targeting process must be made to fit within the decision cycle where appropriate. For instance, not all immediate attack cycles need targeting support, if that support is not value added to the decision.

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There was argument during and after the Gulf War about Intelligence support to the "Black Hole" at CENTAF. Part of the problem evolved from space constraints, which kept targeteers away from the decision makers. Also, the split of the planning functions into two different offices ("Black Hole" and TACC's Combat Plans) led to lack of timely support because of scarce resources. However, the *Summary Report* of the Gulf War Air Power Survey, (p. 128), states "Various planning documents written before the war outlined the organizational relationships that would exist between intelligence analysts, targeteers, and operations planners. Those that developed during Desert Shield and Desert Storm differed considerably from what had been envisioned." In short, we didn't follow our own doctrine.

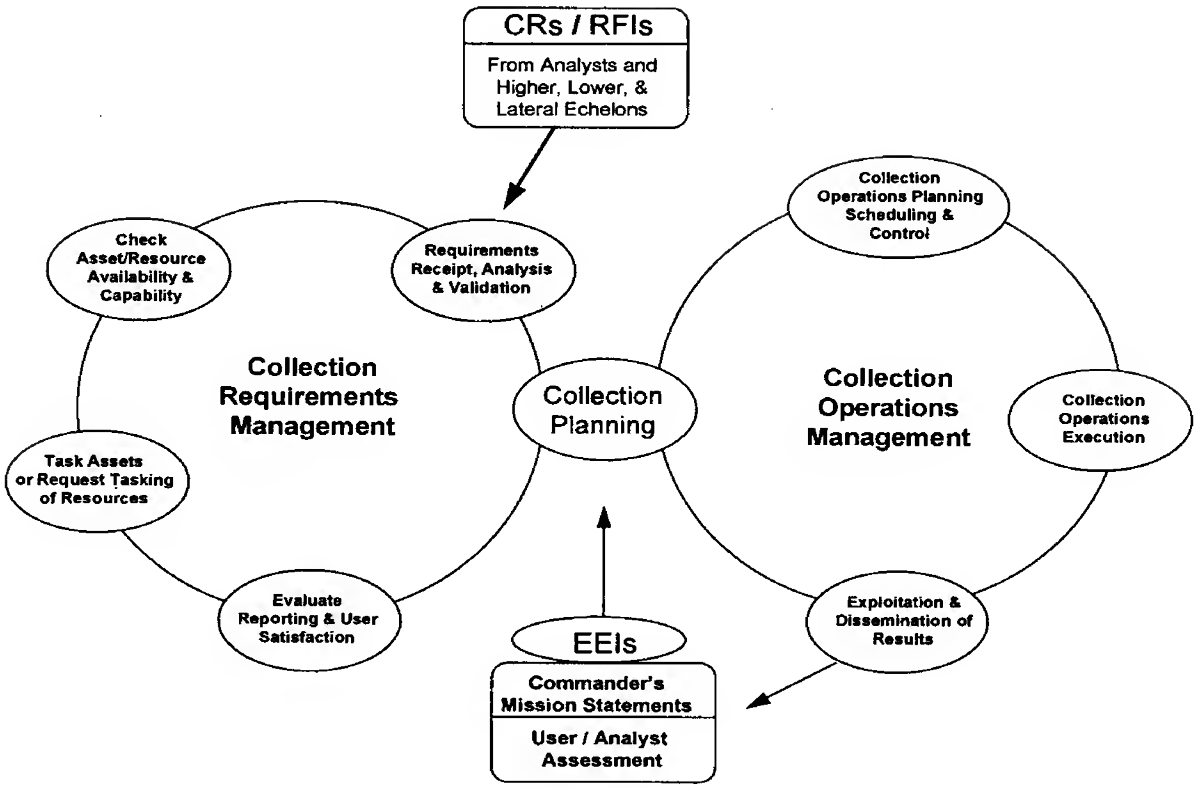
2.5. Intelligence Collection.

2.5.1. Collection Management. Collection management (CM) is defined as "In intelligence usage, the process of converting intelligence requirements into collection requirements, establishing, tasking or coordinating with appropriate collection sources or agencies, monitoring results and retasking, as required." The CM process is a staff activity that is focused on decisions and choices that concern collection requests (CRs) and requests for information (RFI). Such requests may originate from the unit commander, the operations staff, or the intelligence staff. They may also be levied by external organizations, such as theater headquarters, a joint task force headquarters, as well as lateral and subordinate units. The source and scope of levied requirements are typically related to the collection capabilities or tasking/requesting authority of a given unit. There are a variety of ways to task the intelligence system to gain needed information for operational use. A myriad of collectors, ranging from humans to airborne collectors that are controlled manually or are software-driven, are tasked to fulfill intelligence requirements. It is the responsibility of intelligence support personnel at the unit level to accurately determine the direction and flow of intelligence information. Intelligence needs, referred to as requirements, are registered based on time sensitivity. Requirements definitions, as they apply to the air operation, are as follows:

- Time Critical Requirements - Requester needs in less than 24 hours, tactical in nature. Missions already employed or alert assets will usually be tasked (e.g., request for the location of a SCUD TEL that has recently launched a missile is a fleeting requirement).
- Routine Requirements - Requester needs in 24 hours or more, supports routine combat operations. Will be addressed through the collections process (e.g., creation of collection targets to search for specific enemy units that have not yet been located in the AOR).
- Standing Requirements - Established before a contingency arises and provides a baseline for the intelligence problem set (i.e., request to monitor airfields for operational activity).

2.5.1.1. The objective of the CM process is to satisfy the commander's essential elements of information (EEIs). These are necessary to accomplish the given mission and assigned operational tasks. The collection manager is a central figure of the process, serving to coordinate and facilitate the activities of two cyclic, mutually supporting functions: the translation and development of taskings, referred to as Collection Requirement Management (CRM), and the employment of intelligence collection resources, known as Collection Operations Management (COM). The two functions are structured to support the operational commander's mission statement in a responsive manner (figure 2.2).

Figure 2.2. The Collection Management Process.



2.5.1.2. CRM is primarily a function of the intelligence staff and accomplished in conjunction with an all-source intelligence production organization. The process begins with a collection plan and continues through the following tasks: receipt, analysis, and validation of requirements; determination of asset or resource availability/capability; request tasking of resources; evaluation of reporting feedback/user satisfaction; and update of the collection plan. In performing CRM, the collection manager delegates the functional responsibility to one or more collection requirements managers. In some instances, depending upon the size and mission of the given unit or organization, the collection manager actually performs the CRM function.

2.5.1.3. COM facilitates the execution of the collection tasking and mission guidance that was developed to satisfy the validated collection requirements and RFIs. It is dependent upon those supporting organizations and other units or agencies that own and operate the collection assets. COM consists of the following tasks: planning and scheduling of collection operations; execution and control of collection operations; exploitation and dissemination of the resultant intelligence products. With respect to COM, the collection manager is usually supported by one or more collection operations managers. They are members of the unit's operations staff or who reside with other units or agencies that actually own and operate the collection assets. Although it is possible for a collection manager to be responsible for performing COM, the function is usually executed by collection operations managers as a result of tasking received from the collection managers assigned staff of collection managers.

2.5.1.4. Collection Requirements . Always state intelligence requests clearly and include precise parameters (desired and minimum required) and a written statement of justification. Parameters should include suspense dates, frequency of coverage, resolution/level of information, and specific viewing angles/direction (IMINT).

2.5.1.4.1. Requirement Identification . Targeteers must ensure collection operations managers are aware of targeting objectives, information needs (quality, quantity, frequency, etc.), and the constraints and limitations imposed on the targeting process. This includes informing the collection manager as soon as possible of tasked targets. The information must include the type and number of desired munitions, in addition to the desired effect.

2.5.1.4.2. Collection Priorities . The value of targets may change during crisis or conflict, and the targeteer must update the collection manager so collection priorities can be adjusted, if needed. Requirements and their associated priorities need to be established for peacetime target surveillance, crisis monitoring, and combat support (in support of targeting, threat assessment, database maintenance, and damage assessment). All targets should be prioritized and monitored on a routine basis. In most cases, higher priority targets are collected with greater expediency and frequency than targets with a lower priority. Mobile targets present a specific collection problem because their data is extremely perishable and current data is essential to target analysis.

2.5.1.5. Collection Operations (Systems) . It is the collection manager's responsibility to make decisions on sensor choice, since they are responsible for managing the assets and choosing the most efficient methods and sensors to satisfy requirements. On the whole, theater sensors are more flexible and have a faster reaction time to collection requirements. National collection platforms are not as flexible and have set times and locations where they will be collecting on a target area. The choice of which targets will be collected by these assets, must be coincident with specific national system collection ground tracks. Dissemination of national system products relies on primary and secondary dissemination methods and equipment in theater. If communication lines are insufficient enough to handle dissemination of imagery, the product will not be reactive to theater needs.

2.5.1.6. Exploitation Requirements . Targeting must also identify the essential elements of information (EEI) required from imagery and all-source analysts. There are two types of EEI - *generic* and *specific.* If *generic* EEIs are requested, the imagery analyst will report all activity and identify all structures on or in the target area. *Generic* EEIs are listed as part of the overall command objectives and may vary in different commands. *Specific* EEIs are instructions the customer/targeteer provides with the RFI to report specific activity/observations (e.g., general BDA of the entire facility or a specific assessment of a critical target within the facility).

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Imagery interpreters were often unaware of several factors critical to Gulf War Battle Damage Assessment. Time-on-target, number and type of munitions, intended effects, and campaign target significance were not passed in the vast majority of cases to the widely dispersed intelligence production organizations. Assessments of BDA were quickly dismissed by operational planners early in the Gulf War. Credibility was never fully restored, and many false lessons learned and negative impressions were created. The targeteer must do everything possible to point the collection managers to the best source for the intelligence they need. Operational planners should remember that in war an action not assessed is still a task and will have to be planned again.

2.5.1.7. Establishing Collection Requirements. Collection requirements may be established with any desired frequency; as a rule, they are established for these periods: daily, twice weekly, weekly, every two weeks, monthly, every two months, quarterly, semiannually, annually, or until satisfactorily acquired. The specific time of collection may also be requested.

Chapter 3

THE TARGETING PROCESS

3.1. Overview. The targeting process is a conceptual construct used to explain how targeting is performed. The process is performed at various levels of command and execution. Though driven by intelligence, it is not the purview of any one community. Community boundaries are beginning to blur between operations and intelligence. This should help consolidate targeting functions. The targeting process includes actions that produce target intelligence and target materials (through analysis and fusion of multi-source intelligence) and applied in support of operational decision making and force employment. This process includes the steps by which targets are recommended and is comprised of six phases:

- Objectives and guidance derivation
- Target development
- Weaponeering
- Force application
- Execution planning
- Combat assessment

3.1.1. These phases are bi-directional and iterative. Often, they overlap and targeteers perform several of them simultaneously.

3.2. Phases of the Targeting Process.

3.2.1. Objectives and Guidance Derivation . Objectives and guidance derivation comprise the foundation of the targeting process, originating at the national level and becoming more specific and dynamic at progressively lower echelons of command. Unified command objectives establish priorities for targeting, damage criteria, and restrictions on force employment. Guidance includes principles of war, the international Law of Armed Conflict (LOAC), and established rules of engagement. Objective and guidance should be clear and unambiguous so as to be interpretable at the lowest level of command. The necessary first step as a targeteer is to understand objectives and guidance to provide correct targeting advice to commanders. (Within an Air Force AOC, objectives and guidance will normally come from the Strategy Division.)

3.2.2. Target Development . During target development, a planner analyzes a potential target system and its components to estimate the commander's best course of action to achieve a given objective. All-source intelligence data bases are reviewed and potential target systems and targets are selected for consideration. A subset of target development is target analysis, which examines potential targets to determine military importance, priority of attack, and weapon feasibility to obtain a desired level of damage, casualties or to achieve the desired effect. The selected target systems are then further analyzed to determine their components and critical elements. A priority listing of these critical elements is used for weaponeering assessment. Target development includes validation of the target and nomination to the appropriate authority.

3.2.3. Weaponeering . The output of weaponeering is a recommendation of the quantity, type, and mix of lethal and non lethal weapons needed to achieve a probable level of target damage or effects while avoiding unacceptable collateral damage. It is important to note weaponeering results are probabilistic and not predictive. Considerations are:

- Target vulnerability
- Weapon effects
- Munitions delivery errors
- Delivery tactics
- Damage criteria
- Probability of kill
- Weapon reliability

3.2.4. Force Application. Force application planning is the fusion of target nominations with the optimum available lethal and non lethal force. In this phase, forces are analyzed to determine likely results to be achieved against target systems and their activities. For lethal force, this is based on probabilities of damage and arrival for a weapon system. For non lethal force this is based on the expected outcome (consequences). The result of force application is a strike package nomination for the commander's approval that has coordinated recommendations from operations, plans, and intelligence. This includes actions in preparation for attack once force selection recommendations are approved. Targeteers prepare the target intelligence portion of plans and assist in air tasking order (ATO) preparation.

3.2.4.1. During force selection, targeting analysts work closely with operators and planners to match targets with available weapon systems, munitions, and possible non lethal force options. Force sizing is then optimized in light of available resources and other constraints.

3.2.4.2. Targeteers also assist in attrition analysis or calculations for potential friendly force losses to enemy defenses. Attrition analysis bears on both delivery tactics and optimal force sizing.

3.2.5. Execution Planning . Execution planning is the more detailed planning required to actually fly the mission and employ weapons. It is both a component and unit function. At the air operations center (AOC), preparation for the execution of the ATO entails review of plans, weather, logistics, and current situation. At the unit level, it involves mission planning. Unit functions for targeteers have evolved with the automation of mission planning tools, and the laborious work of hand drawn radar predictions, old mensuration tools, and slide rule weaponeering is approaching an end. With a single Air Force-wide intelligence tool (Combat Intelligence System) and a single mission planning tool (Air Force Mission Support System), we have begun to standardize targeting tasks and ease training problems.

3.2.5.1. Targeteers provide the approved targets list, weaponeering, and target materials, such as maps, charts, mensurated coordinates, and imagery. They assist operators in selecting mission routing, axis of attack, aimpoints, and fuze settings.

3.2.5.2. Targeting planners also prepare mission folders containing charts (annotated with ingress and egress routing, and aimpoints), strip charts, threat data, and battle damage assessment (BDA) reporting guidelines.

3.2.6. Combat Assessment . Effective campaign planning and execution require a continuing evaluation of the impact of joint force combat operations on the overall campaign. Combat assessment (CA) evaluates combat operations effectiveness in achieving command objectives and recommends changes to tactics, strategies, objectives, and guidance. It has several sub-assessments including mission assessment (MA), battle damage assessment (BDA), and munitions effectiveness assessment (MEA). The military end state, as written in the campaign estimate and modified during an operation, is directly linked with CA. CA compares the results of the operation to the objectives to determine mission success or failure within the guidance parameters. More important than a review, it looks forward to determine if additional missions are needed and/or if modification to the objectives is necessary. Combat assessment is one concept with many implementations.

Chapter 4

OBJECTIVES AND GUIDANCE DERIVATION

4.1. Overview. The development of objectives and guidance is the first and the most critical step in the targeting cycle. Objectives and guidance identify what is to be achieved and under what conditions and parameters. This is the most important stage in the targeting cycle. Without clear understanding of what is to be achieved, it is impossible for efficient targeting strategies to be devised. An objective must be understandable, attainable, measurable, and allow room for a solution. Objectives and guidance begin at the national level as broad concepts and should end as short-term, well-defined mission objectives at the appropriate command level.

4.2. Objectives and Guidance. In this first phase of the process, objectives are determined and defined and guidance is explored for operational and targeting limitations. Specific guidance is essential for determining the best targeting alternative for a given situation. The term "objectives" and "guidance" are often viewed as synonymous, but they are not. Objectives are the goals calculated to serve national interests which we want to attain. They provide targeteers a means to determine targeting priorities and they set the criteria for measuring mission success. Guidance sets the limits or boundaries on objectives and how we attain them. It provides the framework to achieve the objectives and establishes force employment scope and restrictions. Inherent in the concept of objectives is that they are hierarchical. Objective definition, and therefore specificity, is most often greater at each layer of C2 down the chain from national, to theater, to component, to wing, to flight package.

4.3. Levels of Objectives. Objectives can be broadly classified to three areas: national, theater, and component. Each level down normally becomes more specific.

4.3.1. National Objectives. The National Command Authority (NCA) is responsible for setting national objectives. These objectives are usually very broad and generally outline the overall desired outcome of the campaign. It is vital that these objectives be defined before any military activity occurs because they will determine the course of action. The National Military Strategy (NMS) provides strategic guidance for the employment of military forces, and required force structure to attain the national security objectives (see Joint Pub 3-0).

4.3.2. Theater Objectives . The theater Commander in Chief (CINC) is responsible for objectives for the theater of operations. These objectives often involve all forces in the theater and are therefore broad in scope. They frequently are embedded in operations plans or contingency plans. These plans normally specify the threat, forces available, commander's concept of operations, and specific command objectives. These objectives may be, individually or together, rolled into Courses of Action (see Joint Pub 3-0).

4.3.3. Component Objectives. To accomplish the objectives of theater CINC, component commanders develop plans for the employment of forces. Commanders base the objectives on the overall role of the command, the assigned mission (s), the resources available, the characteristics of the enemy, and the military characteristics of the operational area. Components normally supplement operation and contingency plans.

4.3.4. Relationship of Objectives . The different levels of objectives are all intertwined. The component's objectives are based on the objectives set by the theater CINC which are contingent upon the national objectives. There should be no conflicting objectives among the components. Targeteers must be cognizant of all objectives. **Table 4.1.** illustrates the relationship of three levels of objectives during the Persian Gulf War.

Table 4.1. Persian Gulf War Objectives.

National objectives	**Theater objectives**	**Component objectives**
Achieve the immediate, complete, and unconditional withdrawal of Iraq forces from Kuwait	Neutralize Iraqi leadership and command and control	Destroy leadership's military command and control. Disrupt leadership's ability to communicate with populace.
	Gain and maintain air superiority	Destroy all radar controlled surface-to-air threats. Establish Air supremacy in the Kuwait Theater of Operations.
	Sever Iraqi supply lines	Prevent the resupply of Iraqi ground forces. Destroy key electrical grids and oil storage. Limit military resupply capability.
Remain committed to the restoration of security and stability of the Arabian Gulf	Destroy Republican Guards	Disrupt and attrit Republican Guard forces
	Destroy Iraq's chemical, biological, and nuclear capability	Destroy Iraq's chemical, biological, and nuclear capability
Restore Kuwait's legitimate government.	Liberate Kuwait City with Arab forces	Provide close air support to ground troops as needed

4.3.5. An objective defines the specific targeting problems to be solved. Measurable, definitive objectives must be given or derived from the guidance provided. A good objective must be understandable, require action, be attainable, allow some room to reach the solution, and provide criteria for use in measuring both progress and effectiveness.

4.4. Defining Objectives. Eight questions should be answered when defining an objective.

- What do we want to make the enemy do?
- Against whom?
- How do we want to reach the objective?
- Why do we want to reach the objective?
- How much (to what degree) do we want to affect enemy activity?

- When and for how long do we want to reach the objective?
- Where do we want to affect enemy activity?
- How much will it cost to achieve the objective and is it worth the cost?

4.4.1. What Do We Want To Make the Enemy Do? Identify the enemy activity to be affected, changed, or modified. Normally, only a few enemy activities are encountered: offensive and defensive air operations, ground activity, naval activity, logistic activity, and economic activity.

4.4.2. Against Whom? The specific goal (rather than a generalized or national goal) must be identified. For example, do we wish to modify the behavior of political leader, military forces, the civilian population, or a combination of these three?

4.4.3. How Do We Want To Reach the Objectives? A variety of means toward an end generally suggest themselves. Bombing strikes or attacks, display of intent or demonstration of force, airborne or missile attack, psychological operations, etc., are some choices available. There is also a wide choice of weapon systems available. In most cases, they will be combined. The systems available, or the situation, may dictate the use of a specific vehicle to achieve a desired targeting objective. For example, a B-2 may be the only delivery vehicle able to reach a particular location in time to act. No decision should be arbitrary. Decisions on objectives should recognize external factors which may compel analysts to limit their investigation.

4.4.4. Why Do We Want To Reach the Objective? There is always a "why." Frequently, the "why" has not been thought out, is poorly stated, or is misunderstood. Not understanding "why" may result in analysis and recommendations which neither meet the commander's needs nor are as effective as they could or should be.

4.4.5. How Much (To What Degree) Do We Want To Affect Enemy Activity? State the criteria against which progress and success will be measured. Criteria must use quantifiable terms and be realistic. Criteria should assist in understanding objectives by providing a performance measure. For example, an objective such as "gain air superiority" is not specific enough; it has no measurable criteria. It might be stated better as "gain air superiority by degrading enemy operational capability to inflict damage on friendly forces by reducing the enemy's strike sorties to less than 10 per day," or "gain air superiority by reducing friendly attrition to less than two percent of sorties flown per day."

4.4.5.1. Establishing Measures of Performance . Avoid the use of absolutes in establishing measures of performance, because they are neither realistic nor achievable. As a rule, reduction in enemy activity rates is a nonlinear curve that flattens out as it progresses towards a high probability of affecting overall enemy activity. It is almost impossible to eliminate all enemy activity. For example, in a given case, 100 friendly strike sorties may reduce enemy sortie rates by 50 percent; but 200 friendly sorties may only reduce enemy sorties by 75 percent; and 300 sorties may reduce enemy sorties by 82 percent; etc. Another example involves the interdiction of enemy supply activity. It is possible to hinder, impede, or slow down, and destroy part of the enemy's supplies. That is, it is possible to severely hamper that resupply effort, but it may prove nearly impossible to stop it entirely. Figure 4.1 illustrates performance measurement during World War II.

Figure 4.1. Planning Performance Measurements.

This is key to combat assessment and future objective development. Performance measurement must be common in all levels of planning to ensure that each objective achieved helps to reach the overall objective. World War II provides a good illustration.

One national objective of the United States was to secure peace in Europe through the defeat of the Axis powers. American leaders decided that force was necessary to achieve this objective. The Joint Chiefs of Staff prescribed the way in which force was to be used in the form of a military strategy--in this case, the liberation of occupied Europe and the occupation of Axis territory. The measure of performance for military strategy was its effect on the enemy--whether the strategy would cause the enemy to modify its behavior in the manner the United States wanted. The goals of the military strategy were to be met by a number of campaigns, such as the bombing offensive against German industry and the invasions of France. These campaigns in turn entailed day-to-day operations and their specific objectives. Subsequently, the results of each day's operations contributed to the results of the campaign. The results of the campaign in turn contributed to the military strategy. The success of the strategies (military, political, and economic) contributed to attaining the national objective. The common measure of performance was how the friendly operations affected Axis behavior. It still is.

4.4.6. When and For How Long Do We Want To Reach the Objective? Four principle timing factors must be considered in formulating an objective:

- Timing of the attack.
- Timing of strike impact on enemy operations.
- Synchronization of Attacks.
- Recuperation or reconstitution time.

4.4.6.1. Timing of the Attack . Determining the most opportune time to attack to gain maximum benefit while minimizing cost is a key to targeting. The inherent speed and flexibility of airpower can best be exploited through synchronized, parallel attacks on the enemy's centers of gravity. When properly timed, parallel attacks can overwhelm the enemy's command and control and defensive systems, creating strategic paralysis. This principle was brilliantly applied on the opening night of Desert Storm, as the Iraqi air defense network was struck with precisely timed parallel attacks and quickly rendered ineffective. The Iraqi defenses were first blinded by nearly simultaneous attacks on early warning radars, then paralyzed by successive attacks on key command and control nodes.

4.4.6.2. Timing of Strike Impact on Enemy Operations . The timing of attacks should be based on enemy time-table or "time critical" parameters. "Time critical" parameters are time-sensitive tasks or activities that must be effectively and efficiently performed by the enemy for his plans to succeed. To target the enemy effectively, his goals and tasks (particularly those which are time sensitive) must be identified. "Time critical" periods must be determined. This involves maintaining an intelligence posture capable of detecting, reporting, and assessing the conduct of enemy tasks prior to and during friendly operations. During offensive operations the general attack is followed by resupply or the introduction of follow-on forces. The interdiction of these can severely hamper an attack.

4.4.6.2.1. The time from the attack until its impact is felt is very important. For example, striking or attacking enemy supplies stored near the battle lines will have a more immediate effect on the battle than striking or attacking supplies stored in rear area warehouses or striking enemy factories. If the effects of friendly strikes or attacks are to be felt immediately, different targets may have to be selected than if immediate impact on the enemy is not required. Attempts to have an immediate impact may delay the achievement of longer range goals. Such trade-offs must be considered in establishing the timing criteria in objectives. Factors such as enemy supply cushion and reserves are also important considerations in selecting targets for attack for immediate or long term impact.

4.4.6.3. Synchronization of Attacks. Individual attacks should be timed for maximum synergy in achieving the overall objective. The inherent speed and flexibility of airpower can be exploited through synchronized, parallel attacks on the enemy's centers of gravity. When properly timed, parallel attacks can overwhelm the enemy's command and control and defensive systems, creating strategic paralysis. This principle was brilliantly applied on the opening night of Desert Storm, as key air defense nodes were struck in precisely timed parallel attacks and quickly rendered ineffective.

4.4.6.4. Recuperation and Reconstitution Time . Recuperation and reconstitution times are also critical in targeting. The period during which the target is to be neutralized will influence the type and amount of force to be used. For example, a few aircraft could attack local defenses and achieve local air superiority for a limited time, but it would take many more aircraft to gain air superiority or supremacy over a long period. Recuperation time should always be considered when formulating combat assessment (CA) criteria.

4.4.7. Where Do We Want To Affect the Enemy Activity? The specific location where activity should be modified is a significant part of the objective. By stating "where," the workload of the target analyst can be greatly simplified. For example, if only local air superiority is required, there is no need to prepare an analysis to support attaining air superiority for the entire country. Time constraints limit analysis.

4.4.8. How Much Will It Cost To Achieve the Objective and Is It Worth the Cost? Assuming the objective is attainable, make an estimate of the cost (time, resources, manpower, etc.) and the potential benefit to be derived from a successful operation. We must weigh carefully the cost and benefit of different alternatives. The decision maker should be informed where cost can be lowered by modifying the objective. The decision maker must also be told, if the cost seems too great for the benefits gained. This question supports the military principle of Economy of Force.

NOTE: Figure 4.2 provides a worksheet for understanding objectives.

Figure 4.2. Worksheet for Understanding Objectives.

#_______Objective:

____

Identify the enemy activity to be affected. (i.e., WHAT do we want to do?)

____

____

Identify the target system(s) performing the activity. (i.e., Against WHOM?)

____

____

Identify logical, available assets that can reach the objective target(s) in the time constraints noted in guidance.
(i.e., HOW do we want to reach the objective?)

____

____

State attainable, quantifiable criteria against which effectiveness/success will be measured.
(i.e., TO WHAT DEGREE do we want to reach the objective?)

____

____

Determine the most opportune time and duration to impact the enemy.
(i.e., WHEN and for HOW LONG do we want to impact the objective?)

____

____

Identify the specific location where enemy activity should be modified.
(i.e., WHERE do we want to affect the enemy activity?)

Perform cost analysis to estimate the cost versus potential benefit.
(i.e., HOW MUCH will it cost to reach the objective, and is it WORTH it?)

Check the draft objective against U.S. policy, U.S. military strategy, and all known guidance.
(i.e., WHY do we want to reach the objectives?)

4.5. Types of Guidance. Given that objectives are the goals we want to attain, then guidance sets the limits or boundaries on objectives and how we attain these goals. There are two different types of guidance, general and self-imposed. General guidance is the international unwritten and written rules of war (e.g., Principles of War). Self-imposed guidance is made up of LOAC, Rules of Engagement and Command Guidance (the latter two can change with each conflict and command).

4.5.1. Principles of War . Primarily following Sun Tzu (500 BC) and Clausewitz (1800 AD), Colonel J.F.C. Fuller is recognized as the author of the modern principles of war. In 1921, the US Army listed Fuller's eight strategic principles, plus the principle of simplicity, in War Department Training Regulation 10-5, "Doctrine, Principles, and Methods." The principles we use today are essentially the same. Table 4.2 lists these modern principles of war.

Table 4.2. Principles of War.

Principle	Discussion
Objective	Direct military operations toward a defined and attainable objective
Offensive	Act rather than react and dictate the time, place, purpose, scope, intensity, and pace of operations
Mass	Concentrate power at the decisive time and place
Economy of Force	Create useable mass by using minimum power on secondary objectives

Maneuver	Place the enemy in a position of disadvantage through the flexible application of power
Unity of Command	Ensure unity of effort under one commander
Security	Protect friendly forces from enemy actions
Surprise	Strike the enemy at a time or place, or in a manner for which he is unprepared
Simplicity	Avoid unnecessary complexity in military operations

4.5.1.1. The two most important principles to the targeteer are objective and economy of force. As stated earlier, a well-defined and measurable objective will result in effective force employment. In addition, the targeteer needs to apply the principle of economy of force and determine when military action is inappropriate. This occurs when the potential for losses to friendly forces outweighs the advantage of achieving the objective or when the amount of force required becomes so high that the objective is not worth the effort.

4.5.2. Law of Armed Conflict . The Law of Armed Conflict (LOAC) constitutes that part of international law that regulates the conduct of armed hostilities (see attachment 4). LOAC imposes restrictions on the types of weapons that may be employed and the targets against which weapons may be applied. The primary purpose of LOAC is to protect civilian populations as well as prisoners of war, the wounded and sick, and shipwrecked. Two principles that form the foundation of LOAC are military necessity and proportionality. Military necessity requires combat forces to engage in only those acts necessary to accomplish a military objective. The principle of proportionality serves as the fulcrum for balancing military necessity and unnecessary suffering to the civilian population. Therefore, combat forces must attempt to minimize collateral damage. These two principles are woven throughout almost the entire LOAC and understanding these will enable personnel to understand what is and is not lawful.

4.5.3. Rules of Engagement (ROE) . ROEs, as defined by JP 1-02, are "directives...which delineate the circumstances and limitations under which United States forces will initiate and/or continue combat engagement with other forces encountered." In other words, ROEs are guidelines that we impose upon ourselves. For example, during the Korean war theater commanders placed a five mile no-strike target area below the North Korean and Chinese border. The reason for this was to try to prevent drawing China into the war. During the Gulf War, one restriction was that damage to the Iraqi economy and its capacity for postwar recovery would be limited. This rule was put into effect to keep Iraq as a viable nation, thus furthering the national objective of promoting regional stability. It is the targeteer's responsibility to weigh target nominations against the ROEs and to request exemptions if certain targets are deemed vital enough to the campaign.

Due to all of the possible interpretations of LOAC and ROE, it is essential that targeteers involve the Judge Advocate General (JAG) office early in the targeting process. Early involvement by the JAG can prevent any possible violations of international law or other guidance.

4.5.4. Command Guidance. Theater, major command, unified, and specified commanders provide more specific guidance for the employment of forces to meet objectives. Command guidance comes in many forms and can entail a very broad area of subjects, from approved tactics for aircraft, to proper behavior in local establishments by service members.

4.6. Conclusion. Objectives and guidance are the cornerstones of the targeting process. They guide the later phases of the targeting process and should be clear and well defined. Once developed, theater and command objectives need to be constantly reviewed to assure they accurately reflect the national objectives and any political and international constraints. Because of their role, everyone involved in the targeting process must fully understand the objectives and guidance given by their commanders. If there is any doubt about the meaning of a commander's objective or guidance, it is the targeteer's duty to request further clarification before continuing the targeting process.

Chapter 5

TARGET DEVELOPMENT

5.1. Overview. Target development entails the systematic examination of potential target systems, their components and the elements which make up each component in order to determine the importance, priority, weight of effort, and appropriate weapons selection for specific target systems. It identifies the critical components of a target system and their vulnerabilities to attack or other action. It includes five functions:

- Target analysis
- Target validation
- Documentation
- Nomination
- Collection and exploitation requirements

5.1.1. There are no absolutes to conducting target development. The six targeting functions identified as separate entities in a graphical representation are in fact intertwined. This is never more evident than in target development where the targeteer goes "back" to help refine objectives and guidance and "forward" to weaponeering feasibility, force application, and combat assessment.

5.1.2. Evolution of the Target Development Concept . Targeteers have continually refined the concept of target development. There have been some fundamental problems that may seem obscure to the novice targeteer, but are important to our place in warfighting. Since Intelligence producers have "analyzed" the enemy, what then did targeteers do? Clarification came with the term "target development". We develop targets and inherent to this process is the analysis of targets, the analysis of target systems, and associated activities; but with an operational underpinning. This is the true art of the targeteer--developing targets and bridging the areas (not gaps) of planners and operators.

Foot Stomper Box
If targeteers don't provide full targeting service, then other well meaning but under trained and ill-experienced groups will step in and attempt to provide that which is perceived to be missing.

5.2. Target Analysis. This is an examination of potential targets to determine military importance, priority, and weapons required to obtain a desired level of damage or casualties. It is an open ended analysis of potential enemies. This pamphlet does not attempt to teach analysis, but gives some methods (see **Attachment 5**) proven useful for target intelligence in the past. They are useful for the real world only if they are appropriate to the environment in which they are used. The best analysis is reasoned thought with facts and conclusions, not a checklist. Target analysis is not the sole responsibility of targeteers. Most analysis is produced through the normal intelligence production process based on national and theater validated requirements. Targeteers concentrate on turning those products into target sets. Target analysis can be an iterative process with planners since objectives and guidance will never be finalized before the start of target analysis. Two broad approaches, critical node analysis and target system analysis are described below.

5.2.1. Critical Node Analysis . Nodal analysis focuses on the interaction and interrelationships among multiple target systems to determine the degree and points of their interdependence, as well as the linkage of their activities. More specifically, the analysis focuses on the enemy activities to be affected, not on the characteristics of individual targets. The objective is to determine the most effective way to influence or affect the enemy systems.

5.2.2. Target System Analysis . Target system analysis is a systematic approach to determine enemy vulnerabilities and exploitable weaknesses. It determines what effects will likely be achieved against target systems and their associated activities. A targeteer must review the functions and interactions between components and elements of a target system to determine how the system works. The analysis provides the understanding for determining what effects are likely to be achieved by attacking the system, where the system must be attacked, and how long the attack will disrupt enemy plans or operations. By reviewing probabilities of damage and arrival for a weapon system, targeteers can evaluate the effects of attacks on different components and isolate relevant elements to plan the disruption or neutralization of an entire target system.

Foot Stomper Box Target analysis is a core competency within the targeting process. Don't just think about target systems, but think through the analysis. DIA has produced a solid document in *Critical Elements of Selected Generic Installations*. Just remember it is generic and not every power plant, etc., is built the same. Not every objective has a corresponding set of critical elements. Doctrine has generally accepted a common term for the product of target analysis, "center(s) of gravity". These concepts need to be further developed from the analysis of the enemy in their geo-political situation. The use of "centers of gravity" allow discussions on broad goals when specifics are not required.

5.2.3. There are three broad steps to target analysis.

- Identify the target system supporting the activity to be affected.
- Identify target system components.
- Select a method of analysis appropriate to the target system.

5.2.3.1. Target System Identification. The first step is to identify the target system(s) that support the enemy activity to be affected. Air Force doctrine is a good guide for this task. We stress the following target sets are not the only answer nor are we suggesting these are the best answers. They are a good place to begin. Therefore, the best place to start is looking at the roles and missions assigned. **Table 5.1.** and **Table 5.2.** show some generic representative target systems for various roles and missions of the Air Force for use by targeteers. Again, we stress this is not a checklist but a good example of where airpower was used to advantage in many past conflicts and with a view to the future.

Tables 5.1 and 5.2. Generic Target Sets by Mission. The first step is to identify the target systems supporting the enemy activity to be affected. There are several general categories of enemy target systems. Each is often associated with executing a standard Air Force strike or attack mission:

Table 5.1. Example of Target System - Control.

Roles Control	Missions	Sub Missions or Target System	Target Sets or Tactic	Target & Aimpoint Examples
	Counterair	Defensive CA	Combat Air Patrol	(Our side of the border)
			AD-Surface to Air	(Army owned-JAADC controlled)
		Offensive CA	Sweep	Aircraft
			Airfields; AD & Multi-role	Sortie generation-T/O surfaces
				Ammo-warhead mating
				Maintenance
				Logistical storage-Ammo, POL
				Aircraft revetments, hangerettes
				Aircraft
				Other-Pilots, barracks, etc.
			Power Projection	Offensive missiles *
			Air Command and Control	EW/GCI *
				AD HQ-region, sector, FACP *
				ATC/Nav aids *
			Air Logistics	Maintenance & repair bases
				Air depots
			SAMs	SAM sites
				SAM maintenance & depots
	Counterspace		Space Control Facs	Trackers
			Space Launch Facs	Launcher
	Counter Information	Offensive CI/ C2W	Telecommunication	Switching centers *
			Computer Manufacturing	Chip storage area
			Information Processing	Computers

Table 5.2. Example of Target System - Strike.

Roles	Missions	Sub Missions or Target System	Target Sets or Tactic	Target & Aimpoint Examples
Strike				
	Strategic Attack (Ability to wage war)			
		Command, Control & Comms	HQs-Nat/Thtr/Regional Government Control Tele-communication Intel collection activities	Ops center bunker Gov administrative, ministries Phones, radio/TV SIGINT site, Intel processing facility
		War sustaining industries	Armaments production POL	Rolling Mill, chemical handling area Cracking tower
		War supporting industries	Electricity Equipment production Basic industrial processing Research and development Ports	Production and dissemination Truck plant, computer plant * Cement plant, steel mill Laboratories, test facilities Cranes
		Weapons of mass destruction	Research & development Production Storage	Laboratories, test facilities Plutonium separators Bunkers
	Interdiction	Lines of communications	Road transportation Railroad transportation Water transportation	Bridges, convoys, truck parks Bridges, yards, sidings, trains Locks, terminals, boats
		Storage depots		Warehouses
		Maritime operations	Infrastructure Order of battle Sea Control	Naval facilities Ships Coastal defense sites
		Air lines of communications	Heliborne resupply	Fuel bladders

	Close Air Support		Ground order of battle	Artillery, tanks, trucks, defenses

NOTE: * Target systems and categories are not exclusive. Asterisk items can fall in more than one group to a significant degree

5.2.3.1.1. Control. Control includes counterair, counterspace, and counter information operations. Targeteers are especially involved in offensive counterair and offensive counter information operations. Offensive counterair targets include aircraft, SAM and antiaircraft artillery (AAA) sites, air bases, air control systems, aviation POL stores, and other elements. Counter information targets include information via attack on facilities, hardware, software, or data.

5.2.3.1.1.1. Counterair Operations. Counterair operations aim to defeat or neutralize the enemy's air and missile forces.

5.2.3.1.1.2. Counterspace. Counterspace objectives include gaining and maintaining control of activities conducted in or through the space environment.

5.2.3.1.1.3. Counter Information. Counter information seeks to establish information superiority through control.

5.2.3.1.2. Strike. Strike includes strategic attack, interdiction, and close air support operations.

5.2.3.1.2.1. Strategic Attack. This system includes the vital military and economic targets that constitute a nation's war making capability and those targets essential to postwar recovery. Targets in this system include nuclear and conventional military capabilities, as well as political and economic resources.

5.2.3.1.2.2. Interdiction. Air interdiction (AI) operations are conducted to destroy, neutralize, or delay the enemy's military potential before it can be brought to bear effectively against friendly forces. Interdiction is conducted at such distance from friendly forces that detailed integration of each air mission with the fire and movement of friendly forces is not required. Some examples of target system components include: bridges, roads, railroads and classification yards, supply depots, maintenance and port facilities, waterways, petroleum storage areas, petroleum pipelines and logistics facilities, aircraft, ships, and vehicles.

5.2.3.1.2.3. Close Air Support. Air support by fixed or rotary wing aircraft against hostile targets that are in close proximity to friendly forces, with deconfliction of each air mission with the fire and movement of the friendly forces. Components of this type of target system include enemy troops, armor, artillery, and support elements.

5.2.3.1.3. Exceptions to the Rule. There are many examples of targets not apparently connected to the objective. The destruction of electric power generation normally is associated with the strategic attack mission but, if a country has electrified rail, it could also be considered an interdiction mission. The destruction of an Iraqi railroad repair factory (strategic attack) during the Gulf War might have prevented the Iraqis from quickly moving two Republican Guards divisions on railcars south (interdiction) toward Kuwait in October of 1994. Keep in mind each enemy's infrastructure is different.

5.2.3.2. Identify System Components and Specific Activities of Each Component. The second step is to examine major target systems and determine functionally related activities. By detailing the target system components and mapping out the activities' (functions') input and output you will have a good idea of which components may be impacted. Examples of major groups of target categories from the Modernized Integrated Data Base (MIDB) to consider include:

- Raw materials
- Basic processing
- Basic equipment production or manufacture
- Basic services, research, and utilities
- End products (chiefly civilian)
- Materiel (chiefly military)
- Places, population, and government leadership
- Air and missile facilities and joint commands
- Military troop facilities

Foot Stomper Box Although many targeteers began their careers as imagery interpreters or in SIGINT, it is not necessary to be an expert in those skills to be effective in target system analysis. First, much work has already been published on generic industries and utilities. These generic critical components, such as those found in DIA's *Critical Elements of Selected Generic Installations,* are also documented in other, more specific Intelligence publication. But don't stop there. On the Air Force Targeting Homepage on INTELINK you will find links to many potential sources.

5.2.3.2.1. Potential targets may be located in various installation lists by category. An installation list is a compendium of objects or areas used primarily for reference purposes. An example is the MIDB, which contains worldwide installation lists related to orders of battle. MIDB has been designated the migration system for the production and use of general military intelligence data. It is being designed to incorporate several programs into a single set of common core database structures and analytical applications. MIDB will refocus the Integrated Data Base (IDB) toward the intelligence data user through a series of user interface upgrades that allow a friendlier operating environment. It will also improve the "tools" available to the user and include: look-up tables, help features, standard query tables, a graphical display capability, and improved data output through a broader reports capability.

5.2.3.2.2. It is important to include all potential targets in the analysis. Although intuition, past experience, rules of engagement, and judgment may favor the exclusion of a given target, complete analysis may yield unanticipated results. All analysis should be as thorough as circumstances, time, and resources allow.

5.2.3.2.3. After the target system is understood and individual targets identified for analysis, the target analyst should gather intelligence describing the characteristics of each one. Collection requirements, RFIs, and production requests (PR) are input during system analysis. This is normally where collection managers are brought in to help refine requirements for intelligence production. Products such as intelligence dossiers, folders, and/or automated files have been produced for many installations and target systems. These files provide historical information as well as target descriptions. The National Target Base (NTB) maintained by STRATCOM/J5 to support development of the Single Integrated Operational Plan (SIOP) represents one example.

5.2.3.3. Selection of Analysis Method . The analysis method selected should be appropriate not only to the target system but also understood by the people doing the analysis. All analysis tools have their strengths and weaknesses. If the targeteer does not understand the meaning behind the final answer then they do not have a good answer. Several methods of analysis follow, beginning with a traditional method of building a target system model and developing utility measurements.

5.2.3.3.1. Traditional target system analysis consisted of building a model. In broad terms, a model is a representation of a complex system (usually smaller than the system). By building a model, the relationship between components of the system can be portrayed using textual descriptions, flow charts, graphical depiction's, or mathematical models.

5.2.3.3.2. An element in modeling is the establishment of utility measures, which are numerical ratings or weights assigned to system components to help the analyst compare targets and determine which has a higher importance than another. The numbers do not have to be real or represent any specific characteristics but are used only to show relationships between components. Promising potential targets can be determined and a measure of worth or value attached to each, reflecting its importance or contribution to the system to be affected or modified. Values may be based on a purely functional determination or based on value to the enemy.

5.2.3.3.3. Target Value Analysis. Any target evaluation system must simplify a complex environment into a relatively small number of measurements that can be used to determine whether a proposed attack plan will have significant impact in terms of a specified goal. To be worthwhile, the system must be broad enough to include all relevant types of measurements and indicators. It must be structured into an orderly and systematic framework that will enable replication from situation to situation. It must also be flexible enough to be useful in a wide range of situations. In short, the system must strike a balance between too little and too much analysis.

5.2.3.3.3.1. Target value analysis uses both qualitative and quantitative analysis. While the basis of target value analysis is qualitative decision-making (choosing among values), the techniques are quantitative. People and computers are both necessary for high quality target value analysis. In deciding the best way to attack a target system, the best decision shaping computer is an experienced targeteer. The problem is not merely one of developing a computational process for decision shaping, but of making effective use of knowledge, training, and experience in the process. Some tasks are best accomplished by humans and others by machines, and the best qualities of each must be used in the decision-shaping process. The machine can call forth and structure the information stored and available to targeting personnel, presenting accurate and complete data rapidly. The human participant can provide initial data, assign values to materials, and make decisions based on the data presentations. One of the most difficult and most important input is the measure of target value or utility.

5.2.3.3.3.2. The key concept in target value analysis is the need to analyze targets in terms of their comparative or relative worth. Central to this effort is the concept of "measurability." If a target cannot be measured in terms of its worth relative to another, then no premise exists for analytical reasoning. Certainly, it is much easier to measure factors such as relative worth in a micro sense; that is, to look at the small picture. It is much more difficult to determine such characteristics in a more complex problem. For example, it is easier to determine a relative ranking of targets within a given category than it is to rank targets of different categories. There are several useful approaches for determining relative rankings or value assignments in solving complex problems. Some of the relevant aspects of these approaches are discussed below.

5.2.3.3.3.3. Certain considerations are important for all targets systems when determining which elements are appropriate for attack. Though many are not specifically quantifiable, the targeting planner should think about the following characteristics when attempting to assign a rank order to the various components of a system:

5.2.3.3.3.3.1. Importance and Significance . Importance is a rough classification of the value to enemy military operations derived from all types of equipment, supplies, installations, and personnel used by enemy forces. Significance is the measure of concern for an activity or resources in excess of the value which would be assigned because of its normal performance (its importance). The measure may reflect military, economic, political, psychosocial, or geographic significance. Special significance assigned to a system may not reflect rational thought processes by the enemy and may be very difficult to assess. It is important to note that the concept of Importance and Significance is more than a semantic argument. It shapes decision making and adds validity to the targeting decision. An example of the difference follows. Tikrit, Iraq, is a medium size town with few war supporting and war sustaining functions. It is of medium-to-low importance to Iraqi war making capabilities. Tikrit is significant as the home of Saddam Hussein's family and personal power base.

5.2.3.3.3.3.2. Depth . Depth is a measure of the time required before disruption of a component's activity affects the system output. Average depth is a time concept designed to measure the average interval between the time the production of an item begins and the time the finished product appears in use by a tactical unit. If dispersion is ignored and the average depth is considered an actual constant depth, then the depth of item X is the interval between the time production of X stops and the time the shortages of X (or of times requiring X for their production) appear in tactical units in combat. In general, depth computation is important to measure the time available to the enemy to organize substitute consumption, alternate production, or alternate procurement before he suffers military damage.

5.2.3.3.3.3.3. Reserves . Reserves are the quantity of stored resources the enemy may use when the normal supply of the resource is disrupted or when an excess demand is made on a component for its products or services. Assessment of reserves depends upon the estimation of the system use or flow rate. The measure of reserves is the percentage of the products used versus the total products available. To guard against any loss of war-making ability, reserves must be readily available for use, and the quantity must be enough to last until normal supplies again become available. In an ideal situation, the enemy should be forced to consume more of its reserves than it can replace.

5.2.3.3.3.3.4. Cushion . Cushion is a quantity that prevents sudden shocks by absorbing impact. It is a measure of the extent to which a single target component or system can absorb a disruptive influence and continue to produce or provide the required product or service. Viewed from another aspect, cushion is that portion of the enemy's target system that must be destroyed before its military activities are affected. An enemy can usually suffer loss of goods and services up to a point without critical consequences to his military forces. However, once this buffer is destroyed, any further destruction denies the military forces full operational capability. Determining this point for an industry or a military activity requires detailed analysis of a system's operation, including idle plant capacity, replacement and expansion capacity, civilian production use, the production of nonessential military items or services, or production or provision of substitute materials or services. In other words, if a country's military only uses ten percent of the nation's POL refinery capability, then 90 percent of the capacity must be negated to affect the military.

5.2.3.3.3.3.4.1. Process and Equipment Substitutes . Unused capacity in a specific industry can often be modified for use elsewhere in the economy, to replace destroyed capacity. Thus, the kilns used in annealing grinding wheels might be destroyed, yet similar kilns used for producing various kinds of ceramic wares could be adapted to the grinding wheel industry.

5.2.3.3.3.3.4.2. Product or Service Substitutes . This includes saving remaining production of the attacked industry for the most vital military uses and using substitute products for less important purposes. Thus, aluminum can be used for copper in high tension wires to save copper for signal equipment. There is a time dimension that is critical in the substitution process. That is, how rapidly and for how long can the substitute be produced or provided? The impact of costs of substitution (in resources and in inferior performance) in military worth must also be considered.

5.2.3.3.3.3.4.3. Availability of Substitute Supplies and Services from Others

. Even if the product has great military importance and there are no acceptable substitutes, the industry or activity producing or providing it may be rejected as a target if the enemy can obtain adequate supplies from sources other than domestic production such as from imports, reserves, repair, salvage, etc.

5.2.3.3.3.3.5. Capacity . Capacity may be evaluated as either current output or maximum output. Current output represents plant production based on the present labor force, economy of the country, current demand for the product, and demonstrated production over the past two or three years. Maximum output represents full capacity production based upon existing equipment and continuous operation over a 24-hour day.

5.2.3.3.3.3.6. Product or Service Economic Value . This is the estimated cost to the enemy of producing or providing a product or service based on the cost of skilled workers, production plant, support facilities, equipment, supplies, etc. Target systems are grouped into one of three broad categories: sophisticated, costly (expensive) product; mechanized, moderately costly product; and nonmechanized, inexpensive product.

5.2.3.3.3.3.7. Vulnerability . Vulnerability refers to the physical vulnerability of an installation or facility. Size, shape, and hardness all determine how susceptible a target is to damage. Vulnerability affects the size of force required to damage a target, as well as munitions and fuzing requirements. In a systems approach, the most vulnerable and critical portion of a system may be the most lucrative target. Vulnerability can also be measured in informational terms.

5.2.3.3.3.3.8. Reconstitution or Recuperability . This is a measurement of the time and cost required for a system to regain the ability to function after being disrupted. By assigning each type of target a reconstitution or recuperation time factor, such as days required to rebuild the facility or perform the original function again, the amount of target value that can be restored each day can be estimated using the reciprocal of the time factor. The target analyst can then forecast the stages of repair and replacement and determine the timing or necessity for a restrike. These factors depend on the type of installation, availability of repair materials, similarity and interchangeability of the damaged parts, and the importance of the installation to the enemy.

5.2.3.3.3.3.8.1. Type of Installation . Both the function and complexity of installation construction bear heavily on the time and capital required for replacement.

5.2.3.3.3.3.8.2. Availability of Repair Materials . Depending on the installation, repair materials may or may not be stockpiled or even available within the country.

5.2.3.3.3.3.8.3. Similarity and Interchangeability of Parts . This is allied to the availability of repair materials. Special parts can sometimes be obtained from a less important facility. However, often similar facilities by function cannot interchange parts. Such situations are lucrative for exploitation, but require in-depth target analysis.

5.2.3.3.3.3.8.4. Importance and Significance to the Enemy . Iraq chose not to rebuild some of its infrastructure after the Gulf War. The propaganda significance of these damaged functions to the Iraqi leadership outweighed the importance to the Iraqi people. Given this hindsight, was the military effort worth the results?

5.2.3.3.3.3.9. Geographic Location . Targets may be selected or rejected based on their location. Before weapon systems attained global capability, range was the primary targeting consideration in relation to location, and the capability of tactical forces to reach a target still remains an important factor. However, for systems analysts, the location of an installation in relation to the target system may be a valuable clue to the significance of the installation. For example, if a power plant is located near key military and industrial facilities, it is probably more important than a similar one located to serve only consumer needs. Also, if the target is too far removed from the battlefield, it may not have a direct impact on the battle.

5.2.3.3.3.3.9.1. Target location in relation to cultural features is also important since political factors influence target selection. If an attack on a target is considered politically unfeasible because of possible damage to a nearby installation or population center, the target may not receive strike approval.

5.2.3.3.3.3.10. Concentration or Dispersal. This is the geographic distribution of the installations in a target system or of target elements within a target complex. The types of weapons and forces required to neutralize the objective depend on the distribution of elements. Dispersal has a direct bearing on target vulnerability, and an installation with a large number of dispersed elements presents a more difficult targeting problem than does a tightly concentrated installation. Dispersal may also be viewed as a measurement of the time and movement required for the component to meet its demands.

5.2.3.3.3.3.11. Mobility . This is a measure of the time required to shift a component activity from one location to another. Mobility affects both the perishability of the information about the location of the enemy system and friendly systems' ability to detect, locate, identify, and strike the target component.

5.2.3.3.3.3.12. Countermeasures . This is a measure of enemy ability to counteract the potential disruptive activity of the friendly system through active and passive means. Effective use of terrain, camouflage, emission controls, passive defenses (caves, hangarettes, etc.), and active defenses could negate the ability of the friendly system to exert an influence upon enemy component activity. This constitutes another aspect of target vulnerability.

5.3. Target Validation. Target validation ensures all nominated targets meet the objectives and criteria outlined in the expanded guidance. Targets are validated by evaluating and approving recommended targets; validation should occur as early in the strike or attack cycle as appropriate. Certain questions should be considered during this portion of the target development process:

- Do the targets meet Joint Force Commander (JFC) objectives and guidance?
- Does the target contribute to the adversary's capability and will to wage war?
- Is the target operational?
- Is the target significant?
- Is the target politically sensitive?
- What psychological impact will operations against the target have on the adversary?
- What are LOAC and ROE considerations?
- What is the impact of not conducting operations against the target?

5.3.1. No-Fire Lists/Prohibited Target Lists/ Protect Lists. In some situations, the highest-level decision making authorities may require that each potential target be evaluated in light of the rules of engagement, LOAC, or other restrictions and limitations. Potential targets may be withheld and approved for inclusion on a list of targets which may not be struck or attacked. Targets may be submitted for no-hit protection based on their intelligence, operational, or political value, or deconfliction with other ongoing operations such as special operations, deception, or PSYOP. Targets may also be protected based on cultural, religious, or historic value (figure 5.1).

Figure 5.1. Gulf War Joint No-Fire Target List.

"To help strike planners, CENTCOM target intelligence analysts, in close coordination with the national intelligence agencies and the State Department, produced a joint no-fire target list. This list was a compilation of historical, archeological, economic, religious and politically sensitive installations in Iraq and Kuwait that could not be targeted. Additionally, target intelligence analysts were tasked to look in a six-mile area around each master attack target for schools, hospitals, and mosques to identify targets where extreme care was required in planning."   *Final Report to Congress, Conduct of the Persian Gulf War Title V Report*

5.3.2. Desired Damage and Level of Effort Required. The desired level of damage against specific targets influences options and priorities. Guidance may specify guidelines for levels of damage, but the weaponeering assessment may show that some critical targets are not susceptible to significant damage by available weapons or non lethal force application.

5.3.3. Risk of Collateral Damage. Collateral damage is generally defined as unintentional or incidental damage that occurs as a result of an attack but affects facilities, equipment, or personnel that are not militarily acceptable targets. Since this kind of damage is often the focal point for national and international scrutiny, the type and level of force applied against a target must be carefully selected to avoid excessive collateral damage. International law does not prohibit attacks against military objectives even though they may cause collateral damage since incidental damage is inevitable during armed conflict; but this damage should not be excessive in relation to the military advantage anticipated.

5.3.4. Deconfliction. Proposed targets must be coordinated with appropriate agencies in a process called "deconfliction". Deconfliction is a checklist function. This checklist should be developed in the planning process and be appropriate to the organization. The many offices involved must be coordinated with to prevent incidents of friendly fire or propaganda for the enemy. Some examples where deconfliction take place are:

- Special Operations Forces (SOF). The Joint Force Special Operations Component Commander (JFSOCC) must deconflict Special Operations (SO) activities with the JFC and other joint force component commanders to avoid fratricide. This process may be difficult.
- Search and Rescue (SAR)
- ROE monitoring
- Strike histories. Previous BDA and its importance
- Intelligence monitoring/Situational awareness
- Information operations

5.4. Documentation. Though administrative in nature, this fifth step is important. Documentation includes preparing a list of potential targets, dossiers of information on each potential target, and a file of validation request and approval messages. Figure 5.2 is one example of a format and content useful for collecting, organizing, and recording data for target analysis.

5.4.1. A target list, which is different from an installation list, is a list of specifically designated and militarily significant objects or areas against which future intelligence collection, or attack operations are to be, or may be, directed. It is developed in response to a specific directive or contingency, and thus is shorter than an installation list. However, at this point in the targeting process, the target list is a working list that requires more evaluation before specific execution planning can begin.

5.4.2. The target dossier on each potential target should include the following: at least six elements of target identification (BE number or unit ID, functional classification code, name, country code, coordinates with reference datum, and significance statement); available images, target materials, and amplifying text.

5.4.3. Target imagery research through local files is now supplemented through INTELINK and other electronic means including the Image Product Archives (IPA). This is a standardized library function supporting the retrieval of unexploited (raw) and exploited (finished) imagery derived products. These products are available to users at the national, theater, component and unit levels throughout the world. Users have two methods of accessing IPA, either through INTELINK, using network information discovery and retrieval tools (browsers) such as Mosaic or Netscape, or with the IPA-client tool.

5.4.4. Units may be required to produce target folders. The format of Combat Mission Folders can be found in MCR 55-125, *Preparation of Mission Planning Materials*.

Figure 5.2. Example Targeting Worksheet.

DPI/DGZ/DMPI DATA (Use a separate sheet for each DPI/DGZ/DMPI)

a. BE NUMBER
b. CATEGORY CODE
c. INSTALLATION NAME
d. INSTALLATION COORDINATES (UTM AND GEOGRAPHIC)
e. COUNTRY CODE
f. GRAPHIC REFERENCE
g. GRAPHIC DATE
h. DPI/DGZ/DMPI DESIGNATION/LOCATION (ACCURACY)
i. DPI/DGZ/DMPI DESCRIPTION/SIZE/ORIENTATION/AXIS OF ATTACK
j. FUZING/HEIGHT OF BURST
k. CRITICALITY STATEMENT

PLANNING DATA

a. DAMAGE CRITERIA (K-KILL, PTO, etc.) & LEVEL OF DAMAGE
b. ACFT/WPN/MUNITIONS CEP
c. SSPD/FC
d. PROBABILITY OF ARRIVAL
e. DAMAGE EXPECTANCY/COMPOUND DE

f. UTILITY VALUE
g. MARGINAL OUTPUT
h. MARGINAL PRODUCT

5.5. Target Nomination. The products of the previous phases of the targeting process are used to develop responsive target sets. Nominations should show how target recommendations satisfy command objectives and priorities. Additionally, planners should establish and justify options and priorities, and document these efforts before nominating target taskings to the commander. There are different nomination processes between the surface forces and the air forces. Surface forces usually nominate specific targets from the bottom up and air forces normally nominate specific targets at the force level. In any case, Joint Force components nominate requirements outside their own boundaries or exceed the capabilities of organic and support assets within their boundaries.

5.5.1. Responsive Target Set. Target sets are built to respond specifically to objectives and guidance, assigned missions, options, and priorities. Such guidance may dictate that target sets be grouped geographically or be based on specific functional categories. Targets also may be grouped according to unique weapon system requirements. Another grouping may include restricted targets. Specialty target sets may include those selected for the employment of information operations or special operations forces. During the objectives and guidance stage, predetermined percentages for destruction for each target set may have been laid out by the commander.

5.5.2. Target Lists. The recommended target list supports the target nomination briefing to the JFC. Target recommendations may be phased and grouped by mission, operation plan, option, or priority depending on the purpose and audience. They also may be grouped according to recommended weapons, e.g., mines or precision-guided munitions. Furthermore, they may be grouped according to weapon system recommendations, e.g., B-52s or Tomahawk Land Attack Missiles (TLAMs). Targeting personnel should be prepared to provide the full range of information to the operations staff in support of force application. Targeteers and operations planners continue to work together to adjust the recommendations.

5.5.2.1. The targeteer provides the commander or his designated target approval representative with a prioritized list of specific validated targets. This list provides planners with the name, BE number(s), coordinates, function, description, possible aimpoints, effects desired on the target, and tentative weaponeering solutions. The targeteer includes a statement on the significance of the target in light of the commander's objectives. Often, other analyst comments are includes, particularly if the target can be affected through non lethal means. The list may also include additional information such as the requesting service and even a recommendation as to which service should be responsible for attacking that target. A word of caution at this point, the target list has not been finalized--it is a working list that requires more evaluation before specific tasking can begin.

5.5.2.2. Target List Approval Importance . Target lists are important because they drive force employment, as well as production of intelligence for aircrews and missileers. Production of target materials in sufficient quantities and detail for all possible users is a complex and time consuming process that imposes severe demands on scarce resources. Also, the production cannot be quickly expanded in quantity, only focused on subject. This is the reason operations plans'

(OPlan) and a few concept plans' (ConPlan) target lists normally have target materials produced for them. DIA is the manager for production of target planning materials under the *Target Materials Program.* The theater's tactical target materials catalogs (TTMC) are a compilation of only the formal, regulated target material production. They do not include the thousands of target images, "select prints" etc, generated by organic, theater, and national level intelligence producers.

5.5.2.2.1. The newer targeting tools (i.e., Rapid Application of Airpower) should assist in this process by checking such database items as the category code of the target nomination or its location. Also, a new graphical presentation application on RAAP can help the approval process.

5.5.2.2.2. The target list is then sent up the chain of command to, eventually, the theater CINC. This is most often done via briefing at each level. A Joint Target Coordination Board (JTCB) often is designated to formalize the nomination process.

5.5.3. Where Validation and Nomination Occur. While validation or nomination will occur in all phases of the target process, there are certain characteristics that tend to make the majority of nominations fall within force selection/application or within the target development phase. **Table 5.3.** lists their characteristics to distinguish the functions.

Table 5.3. Validation Versus Nomination.

VALIDATION	NOMINATION
Internal	External
Check list function	Formal (but flexible)
Micro	Macro
ROE/LOAC	Decision making
Deconfliction	TARBUL
Desired Pd	Needs acceptance
Continuous/ongoing	Aggregations of nominations
All levels	Between components
Collateral damage	All levels
Documentation	Feedback required
No Fire Lists	Sometimes up channel/sometimes down
Objectives/ CONOPS	
Feasibility	

5.6. Establishing Collection and Exploitation Requirements. The last step in target development is to establish collection and exploitation requirements for each potential target. These requirements must be articulated early in the targeting process to support target development and eventually combat assessment. A good knowledge of the types and sources of intelligence as related in **Chapter 2** and **Attachment 3** will help the targeteer write better Requests for Information (RFI) and Production Requests (PR). One natural area for consolidation of AOC Target Branch collection management inputs is the Combat Assessment Cell where a single POC (per shift) can interface with the Collection Management Branch.

Chapter 6

WEAPONEERING

6.1. Overview. Weaponeering is the process of estimating the quantity of a specific type weapon required to achieve a specific level of damage to a given target, considering target vulnerability, weapon effects, munition delivery errors, damage criteria, probability of kill, weapon reliability, etc. It is the third phase in the conceptual targeting process, but it is embedded into target development, force selection, and execution planning. Weaponeering is a core competency of targeting, although many confuse all targeting with weaponeering. Weaponeers quantify the expected results of lethal and non lethal weapons employment against targets. The recommended target list provides the basis for weaponeering assessment activities. Since time constraints may preclude calculations of potential effects against all targets, calculations should proceed in a prioritized fashion that mirrors the target list. Nonnuclear weaponeering is normally done using methodologies prepared by the Joint Technical Coordinating Group for Munition Effectiveness (JTCG/ME).

Foot Stomper Box. Weaponeering results in probable outcomes given many replications of an event. It does not predict the outcome of every munition delivery. It is a statistical average based on modeling, weapons tests, and real-world deliveries.

6.2. Weapon Allocation. Weapon allocation is the designation of specific numbers and types of weapons for use during a specified time period or for carrying out an assigned task.

6.3. Weapon Effectiveness. Weapon effectiveness is a statistical estimate of the results expected from specific munitions effects, target environment, damage criteria, delivery accuracy, munitions reliability, and ballistics. This should be closely tied to munitions effectiveness assessment in combat assessment.

6.4. Combat Weapon Effectiveness Data. It is difficult to assemble data on the combat effectiveness of a weapon system. Weapons are not operated by laboratory experts methodically following test plans, but by aircrews acting under combat tensions and pressure. Data used in predicting weapon effectiveness must be a valid representation of how both human and machines perform in combat. Very little of this type of information can be recovered from combat experience. Some data can be gained from test firings, if the tests are carefully controlled to allow for the realities of combat, but other data simply is not available and must be extrapolated.

6.4.1. Several complicating factors must be fully considered before the combat effectiveness of munitions can be realistically estimated. Weaponeers and operational planners must consider all of these factors so as not to provide overly optimistic predictions of combat effectiveness:

- Enemy Actions--The effects of enemy actions and countermeasures.
- Delivery Accuracy--The measurement of how closely a system can deliver its weapons or warheads to the target. Delivery accuracy's in JMEM are determined from data gathered in weapons tests and operational aircrew experiences, as well as programs to gather data (e.g., Weapons System Evaluation Program). JMEM data is not the best accuracy ever achieved on the range in noncombat situations, but rather an estimate of real-world expected accuracy.

- Damage Mechanisms--Warhead characteristics producing damage effects, including blast, fragmentation, incendiary, overpressure, dynamic pressure, etc.
- Target Vulnerability--The susceptibility of a target to terminal effects or specific damage mechanisms of a munition.
- Weapon Reliability--Warhead functioning dependability.
- Trajectory--Ballistics and/or weapon or warhead flight characteristics.

6.4.2. The Services, as well as the JTCG/ME, DIA, and the Defense Special Weapons Agency (formerly Defense Nuclear Agency) have developed a number of quantitative techniques used to estimate weapon effectiveness, taking many of these factors into account. The JTCG/ME, for example, develops analytical methods for measuring and predicting munitions effectiveness. It has also produced a large body of scientifically valid data related to specific weapons, munitions, and appropriate targets. The group devised mathematical models which enable weaponeers to predict the effectiveness of weapons against most militarily significant targets. Inputs to these methodologies include factors such as aircraft capabilities and configurations; target characteristics, such as size, shape, and hardness, and delivery parameters (altitudes, speeds, dive angles, etc.). Model outputs include numbers of sorties or passes required to achieve specified damage levels in terms of stated damage criteria. These outputs allow weapons effectiveness comparisons.

6.5. Steps in Weaponeering. There are multiple steps in weaponeering.

- Set collection requirements
- Obtain information on friendly aircraft, weapons, fuzes, and delivery tactics
- Determine target elements to be analyzed
- Determine damage criteria, if analysis of individual targets is to be accomplished
- Determine weapons effectiveness index
- Determine aimpoints and desired impact points
- Evaluate weapon effectiveness
- Prepare preliminary documentation
- Review collection requirements

6.5.1. Set Collection Requirements. The weaponeer can generally obtain most necessary data from the target developer, if the functions are separate, but there are times when special information is needed to perform a weaponeering task. The weaponeer must establish collection and exploitation requirements as soon as they are identified. Requirements for both target development and weaponeering should be coordinated and submitted as a single set.

6.5.2. Obtain Information on Friendly Forces. The weaponeer must know the aircraft, weapons, and fuzes available for use, as well as probable munitions delivery tactics. Moreover, weaponeering results will only be useful to an operational planner if the employment parameters used in the process represent the ones used in combat. In combat planning, where a large number of targets must be weaponeered very quickly, it is advisable to agree upon standard planning factors. Some additional information helpful in making intelligent weaponeering recommendations include: weather, training/readiness posture, target acquisition probability, collateral damage potential, and ROEs. Targeteers should work closely with the operations and logistics staff to obtain this information and keep them up to date. As a rule of thumb, theater component targeting branches should request from their OPlan/ Checkered Flag Time-Phased Force and Deployment Listing (TPFDL) units' expected input options for the Automated Weaponeering Optimization Program (AWOP) to provide realistic planning data. For remote tour areas such as Korea, this data should be requested every six months.

6.5.3. Determine Target Elements To Be Analyzed . The third step in weaponeering is to examine the data provided by target developers or imagery interpreters and decide which elements to analyze for vulnerability. Where is the target most vulnerable and to what weapon effect?

6.5.3.1. Some targets are hardened or designed to withstand specific weapon effects, so it may be difficult to damage or destroy them. Experiences in recent conflicts and use of JMEM approved Munitions Effectiveness Assessment computer programs will help with these difficult weaponeering cases. A hardened structure may often be penetrated and the content damaged or destroyed with little or no damage to the structure itself. Therefore, the basic question which must be answered is "What type of damage must be inflicted on the target to reach the stated objective?"

6.5.3.2. Determining which target elements should be analyzed can be broken down into two activities: first, performing a functional analysis, and second, performing a structural analysis. In preparing a functional analysis, targeting personnel identify the functions of all parts of a target, determine the relative importance of each part, and designate those parts which are vital to target operation. A structural analysis provides much of the information necessary for determining overall target vulnerability. It includes construction types, dimensions of structures, equipment, etc. The results of this analysis will normally determine the components to be struck or attacked. Good resources for analysis include DIA's *Critical Elements of Selected Generic Installations* and USAF's *Conventional Weaponeering Proficiency Refresher*.

6.5.4. Determine Damage Criteria. Target vulnerability data must be expressed in terms of the results desired when a target is struck or attacked. Specifically, a desired level of destruction, damage, or performance degradation is sought to produce a significant military advantage for friendly forces. The desired goal of the attacker is called "damage criteria" or "kill criteria." Damage criteria can be referred to as a quantitative measure of target susceptibility to a given amount of damage.

6.5.4.1. Measurement methods vary considerably with target type, basic input data, and the format of the desired results. Generally, the format of the output data includes: vulnerable areas for penetrating damage mechanisms such as fragments and projectiles; conditional kill probabilities of shaped charges; charge weights and distances; and lethal envelopes for flames. Damage criteria should include time parameters. Tactical plans may require, for example, rendering an enemy vehicle incapable of moving within five minutes after it is hit. A truck farther to the rear of a column may require "20 minutes to stop after it is hit" criterion. Because some weapons may be efficient at achieving the first type of damage and others may more easily achieve the second type, it is necessary to consider differences in damage required for target defeat.

6.5.4.2. There are a large number of different damage criteria for nonnuclear weapons. These include F-Kill (Fire-power kill), M-Kill (Mobility kill), K-Kill (Catastrophic Kill), FC-Kill (Fire Control Kill), PTO-Kill (Prevent Takeoff Kill), I-Kill (Interdiction Kill), SW-Kill (Seaworthiness Kill), Cut, and Block. Some of these criteria are broken into subcategories to reflect different effectiveness levels. The sample damage criteria set below from the JMEM is for aircraft (figure 6.1).

Figure 6.1. Example Damage Criteria for Aircraft.

The target aircraft is to be attacked while parked. Two damage categories are applicable to this target: PTO and K-Kill. Detailed descriptions of specific target damage criteria are provided in the JMEM Target Vulnerability Manual (USAF TH61A1-3-1). PTO damage occurs when, for example, as a consequence of the attack, the aircraft cannot generate enough power for takeoff or the pilot cannot control the aircraft. This damage criterion is presented as PTO 4 or PTO 24, which reflect the minimum number of hours (4 or 24) the aircraft will be inoperable. K damage constitutes basic, irreparable damage to the aircraft. An aircraft suffering K damage is good only for cannibalization and scrap.

6.5.5. Determine Weapons Effectiveness Index. The JMEM have established the effectiveness indexes for nonnuclear weapons. Weapons effectiveness varies according to the weapon, target, damage criteria, delivery conditions, and target environment. There are different ways of stating weapon effectiveness according to the target/weapon combination. The weapon effectiveness and lethality indexes used by JMEM are Mean Area of Effectiveness (MAE), Vulnerable Area (VA), Crater Diameter (DC), Effective Miss Distance (EMD), Bridge Effectiveness Index (BEI), Number of Hits (NH), Probability of Damage (Pd), and Probability of Damage Given a Hit (Pdh). These indexes account for the primary damage mechanisms of nonnuclear weapons.

6.5.6. Determine Aimpoints and Impact Points. The sixth step in the weaponeering phase is to determine the desired point of impact (DPI) or desired mean point of impact (DMPI). In choosing a point of attack, it is usually best, time permitting, to select more than one target element and weapon combination. This allows planners who may be resource or weather constrained to have greater flexibility.

6.5.6.1. For conventional weapons, targets may be unitary targets, area targets, or linear targets. A unitary target may be a point (essentially without dimensions) or a geometric target (with dimensions). An area target consists of multiple unitary target elements. Buildings are treated as area targets unless a single building is considered the primary target. The target area is usually large with respect to the unitary elements assumed to be uniformly distributed in the target area. Area targets may be treated as unitary targets if weapons effects are considerably larger than that target area, or the circular error probable (CEP) is close to the target size, or a combination of the two. A linear target is a long, narrow target such as a road, rail line, or an airfield runway.

6.5.6.2. Multiple DPIs or DMPIs should be used whenever the effective damage area (resulting from the combination of the weapon effective area and the CEP) is considerably less than the area of the target. In all other cases a single point of impact is sufficient. Runway interdiction is a special case, since the runway may have to be cut in more than one spot to prevent aircraft from taking off.

6.5.7. Evaluate Weapon Effectiveness . During this step, various aircraft, missiles, weapons, yields, heights of burst, fuzes, and delivery tactics are evaluated to determine the best combination to use against each individual target. In this step, the weaponeer uses appropriate methodology to determine the solution to the problem. This solution is expressed as the probability of damage (Pd). Pd is used to express the statistical probability that a specified damage criteria can be met assuming the probability of arrival. In a few cases, specific probabilities of damage to individual targets may be indicated by combatant or component command headquarters. Despite this fact, Pd is typically determined by the target analyst. Specific recommendations for probabilities of damage for individual targets are provided in various JMEMs.

6.5.7.1. The data developed by the weaponeer are then given to target selection planners. This data should include the recommended weapons, fuzing, height of burst, as well as the computed damage level. Pd is not an end in itself and does not provide an adequate comparison between targets. Pd must be used in conjunction with such factors as damage criteria and Pa. Damage criteria is a descriptive term (i.e., drop a bridge span, neutralize telecommunications function in HQ building) depicting how you want to affect the target.

6.5.7.1.1. Damage criteria can be incorporated with other factors. For example, the targeteer may find the available force could achieve a Pd of .70 against an aircraft parking area containing 10 aircraft, or a Pd of .40 against an area containing 30 aircraft. Which target should be attacked? On the basis of Pd alone the target with a .70 Pd would be selected. If damage criteria is considered (for this example, the criteria equals the maximum number of aircraft), on the average, only seven aircraft would be killed in the first target area, while 12 would be killed in the second. Therefore, the second target area in the example above should be attacked if all other factors are equal.

6.5.7.2. Although the weaponeer searches for the best combination of weapon and delivery system to recommend for use against a target, they must recognize that their first choice may not always be available due to logistical or operational considerations. Time permitting, the weaponeer should develop an array of probabilities, using different combinations of systems, weapons, fuzes, etc to provide force application planners flexibility. Normally weaponeering is done with more generalized parameters at the force level and unit specific factors are taken into account by the executing unit.

6.5.8. Prepare Preliminary Documentation . The targeteer must provide recommended options and supporting rationale to planners for use in force application planning decisions. Use of a worksheet to collect and organize data for future use or reference is essential. Space should be available for target development, weaponeering, and force application data. The information should include the specific element or point of attack. This point may be specified in a simple textual description, by reference to areas annotated on standard target materials, by reference to the grid provided on a Basic Target Graphic (BTG) or similar product, or by other agreed upon techniques. Precise target coordinates for the point of attack should also be provided. Use of precise coordinates can significantly improve delivery accuracy for nonvisual weapons employment.

6.5.8.1. Target analysts should also recommend fuzes or fuze settings whenever unit level expertise or materials available are limited. When specific effects are required (i.e., arming and self-destruct times for mines), it is essential to provide such information to operational combat units preparing ordnance for the mission.

6.5.9. Review Collection Requirements . After the development, weaponeering, and force selection information is accumulated, gaps in the weaponeer's database can be identified. Collection requirements should be reviewed to determine if they will fill the gaps or will need modification, or whether new requirements should be established.

Chapter 7

FORCE APPLICATION

7.1. Overview. Force application planning is the fusion of target nominations with the optimum available lethal and non lethal force into an operationally sound package. It translates the commander's objectives into a list of candidate targets (target development) and estimates the effectiveness of various fires (weaponeering). In this phase, forces are analyzed to determine likely results against target systems and their activities. For lethal force, this is based on probabilities of damage (Pd) and arrival (Pa) for a weapon system. For non-lethal force, this is based on the expected consequences of the attack. The result of force selection is a strike package nomination or tasking with coordinated recommendations from operations, plans, and intelligence. Of note, when providing support to force applications, targeteers must be cognizant of the need to eliminate bias for a particular weapon, weapon system, or even component force. Likewise, recommendations should reflect an objective assessment of the most appropriate capability to achieve the objective.

7.2. Force Application Levels/Timelines. Force application may be conducted at different levels for different purposes.

7.2.1. Theater . At the theater or joint task force level, commands use force application techniques to conduct Deliberate or Crisis Action Planning**.** A theater commander often uses deliberate planning to determine if he has sufficient forces to conduct a campaign and evaluate "what if" warfighting options. This evaluation is often called "wargaming." Another important area where force application supports deliberate planning is in determining target material (TM) production requirements. By knowing the types of targets and weapons systems used against those targets, TM production agencies can tailor their products towards supporting the warfighters.

7.2.2. Component . The force application process is at the heart of component level planning. That is, it's the "Operational Art of Warfighting." At this level, almost all of the daily decisions an air commander makes are influenced by the force application process. At times, scarce resources may dictate the commander determine which trade-offs to make when employing his forces--an important force application function. Force application is also used extensively to develop longer range plans, outline the time to complete a particular phase of an operation, depict how some targets may be attacked, or provide a picture of the best ways to integrate and use various weapons.

7.2.2.1. In the Air Force, operational level planning occurs at the Air Operations Center (AOC). Targeteers prepare the target intelligence portion of plans and are instrumental in air tasking order (ATO) preparation. They work closely with operations and logistics planners to match targets with available weapon systems, munitions, or possible non lethal force options. Force sizing is then optimized in light of operational realities. Targeteers also assist in attrition analysis or calculations for possible friendly force losses to enemy defenses; attrition analysis impacts delivery tactics and force sizing.

7.2.2.2. As the focal point of the air component commander's control system, the AOC is connected to operations centers of higher and lateral commands, subordinate units, and subordinate Theater Air Control System (TACS) agencies. The AOC provides centralized control with decentralized execution through its subordinate agencies (i.e., Air Support Operations Center (ASOC) and the Control and Reporting Center (CRC)). The AOC prepares and issues orders for force employment and monitors their execution. To do this, the AOC is organized into two functional divisions: the Combat Plans Division and the Combat Operations Division.

7.2.2.3. The Combat Plans Division oversees the evaluation of the overall air plan. They also consolidate requests for air missions (not targets). This results in an apportionment recommendation to commit available air resources, which is sent to the CINC for approval. Based on this commitment an ATO is prepared and issued.

7.2.2.3.1. In making this recommendation, operations and targeting personnel must work together. Considerations for the apportionment recommendation include enemy intentions and reactions to our operations, threat, and objective achievement. The sub assessments of combat assessment are very important to the force application process once operations start. Munitions effectiveness assessments (MEA) drive weapon and tactics selection. Battle damage assessments (BDA) provide indicators of the enemy's capabilities. Mission assessments (MA) detail how well the assigned missions are being performed.

7.2.2.3.2. Targeteers also work closely with the Combat Operations planners on weaponeering and weapon selection. Additionally, they furnish targeting data for reconnaissance and surveillance plans along with ensuring the BDA is efficiently collected.

7.2.2.4. The Combat Operations Division supervises the detailed execution of the ATOs. Through the use of the TACS, it coordinates and integrates all air operations and provides for centralized control in response to designated objectives and the current tactical situation. Targeteers are an integral part of the Combat Operations Division. They monitor ATO execution and recommend alternate targets when necessary. Normally target changes are due to bad weather, BDA, or the discovery of a higher priority target. The ability to quickly recommend good alternate targets is very important to the flexibility of airpower. Combat Operations Division targeteers should have all the significance statements for the targets on the current ATO, the theater and air component objectives, all guidance, ROEs, and weaponeering lookup tables as appropriate.

7.2.3. Unit . Targeteers at the wing are responsible for doing specific weaponeering for their tasked missions. They should tailor this to the capabilities and tactics of their aircrews. Targeteers at the unit should be familiar with their unit's weapons and tactics to include which delivery conditions they normally use and which are not in their units playbooks. The weaponeering planning factor should be published by the AOC so units can ensure they comply with guidance. Wing and squadron commanders are often called upon to make force application assessments for missions that are tasked to the unit level. The mission planning cell reviews the changing threat, weather, munitions effectiveness assessments and can modify munitions load or even the number of sorties tasked against a target to maximize their combat effectiveness. They can also request changes to aimpoints. If unit adjustments can reduce sortie requirements and extend munitions stocks by judicious planning, the benefit is obvious. When a unit wants to make changes to the plans, they must notify the AOC. This minimizes the effect on future planning. For example, if planners assume a unit attacked a particular aimpoint, when in fact they did not, the objective of the attack may not be met.

7.3. Force Application Process. The process of force application reviewed below is traditionally used at the operational (AOC) level to build the ATO. However, force application tasks are universal and are not tied exclusively to the ATO cycle or ATO production. This section is designed to provide a generic look at the flow and thought processes inherent in force application; it is not intended to dictate a particular way to conduct planning. There are five general steps in force selection planning:

- Compile information (results from target development and weaponeering phases)
- Prepare tentative force assignment and assessment criteria
- Recommend targets, forces, weapons, fuzing, and assessment criteria to operations
- Adjust recommendations in coordination with operations
- Present joint intelligence and operations recommendations to the commander

7.3.1. Compile Information. The first step is to gather the data needed for the selection process. The key to successfully conducting force application analysis is organizing pertinent data and information in a coherent format to guide planners towards logical and economic employment options. Experienced planners gather the data they will need well ahead of time and continually update and refine it. They do not allow the sheer volume of information coming into the AOC to overwhelm them. This should not be difficult if a worksheet has been prepared and pertinent intelligence collected on each potential target. The types of information needed include: target development results; weaponeering calculations; forces and operational constraints; and damage expectancy calculations. This data should be in RAAP if the documentation part of target development was done properly.

7.3.1.1. Target Development Results. This can be found in RAAP with information on target significance, contribution to the target system, and its relationship to other system components.

7.3.1.2. Weaponeering Calculations. Includes weapon effects estimates and damage criteria. An array of possible aircraft/weapon combinations should also be included to allow flexibility for the planners. Calculations for nonlethal applications must also be factored.

7.3.1.3. Forces and Operational Constraints. Provided by operations, logistics, weather and legal personnel includes: data on aircraft, weapons and fuzing availability; tactics and employment; objectives, guidance apportionment, ROE, LOAC; weather; and other operational constraints and considerations (e.g., threat picture).

7.3.1.3.1. Aircraft/Weapons Availability. Operations planners maintain this information, provided by logisticians in the Resource Management Center. Restrictions such as the number of precision-guided munition (PGM) qualified aircrews, maximum sortie generation rates, munitions buildup times, and crew rest all impact the number and type of weapons systems available for execution. Planners try to account for all of these considerations in their recommendations.

7.3.1.3.2. Friendly Tactics and Employment Procedures. A thorough understanding of unit tactics, capabilities, unique weapons characteristics, and requirements are essential to effectively plan for weapons employment. Planners must consider all factors in using a particular weapons system or building a package, not just asset availability.

7.3.1.3.3. Apportionment Guidance. This guidance sets forth the JTF commanders' desired weight of effort, expressed as a percentage of the total sorties which will be assigned to a particular mission type (CA, AI, CAS) or geographic area (II Corps, X Corridor) for a defined period of time. Combat Plans "allocates" assets as part of the force application process. The JTF commander must approve any large deviations from the guidance in the apportionment decision, although the JFACC staff is usually allowed some discretion.

7.3.1.3.4. Battle Damage Assessment. Intelligence planners track and monitor previous targeting efforts and update accordingly. Based on incoming BDA, targeteers working in Combat Operations may select new aimpoints, halt restrikes being planned against targets, divert aircraft from low to high priority targets, and develop alternatives in weapons employment.

7.3.1.3.5. Threat Picture . A key objective for planners is to minimize risk to aircrew. Therefore, planners receive regular order of battle updates and have an understanding of enemy threats, particularly enemy doctrine and tactics (lethal and non lethal alike). Weapons selection focuses as much or more so on those weapons which allow for survivable delivery tactics against the anticipated threat as those weapons which give the best Pd. The challenge to planners is to balance desired Pd or weapons choice against the risky delivery parameters necessary to meet them.

7.3.1.4. Damage Expectancy (D_E) . D_E for each target can be calculated using P_d and P_a, and further force selection computations should be based on D_E rather than P_d. The P_a for different systems can vary considerably, and these factors should be reflected in the target analysis. The use of D_E allows the analyst to compare the capabilities of each system and to select the best weapon system for the mission. D_E is the product of P_d and P_a computed for a given single system attacking a single target (figure 7.1). Often the mistake is made of compounding probabilities of damage first and then applying P_a, resulting in an incorrect answer. If more than one aircraft is attacking a target, D_E should be compounded, not P_d.

7.3.1.4.1. P_a Calculations. P_a figures are developed by analysts using intelligence about the enemy defensive posture, capabilities, and intentions; and the anticipated routing to potential targets. Targeteers must provide these analysts an up-to-date target list as soon as practical. Although changes in the final force application process may require last minute adjustments, the P_a figures should be relatively firm. However, they should be prepared as an array for the various available vehicles and delivery tactics that might be encountered with any last minute changes. For nonnuclear weapons, weapon reliability is included in the JMEM methodology for determining probability of damage and should be excluded from the P_a computation.

7.3.1.4.2. Other Considerations . Planners formulate, review, or modify employment procedures based upon the tactical situation. Information operations, psychological operations, and tactical deception, et al., can be used to provide a synergistic effect or advantage to the execution of the ATO.

Figure 7.1. Damage Expectancy Formula.

$D_E = P_d \times P_a$ NOTE: D_E is based on attack by a single system against a single target.

7.3.2. Tentative Force Assignment. In this step, the target analyst tries to determine which targets will be attacked by which forces. The targeteer must use as much operational data as possible in performing this task. However, the specific forces and weapons can only be determined by operations personnel who actually select the targets. Operations personnel who make the final force application decisions will then adjust these recommendations. A targeting oriented solution is absolutely necessary to ensure that target intelligence and weapon parameters are satisfactorily reflected in the final force assignment.

7.3.2.1. The targeteer must compare the expected effects of the tentative force selection to the stated daily operational and campaign objectives and adjust the input to the selected model and rerun, if necessary. If the tentative solutions do not satisfy the operational objectives, the targeteer should reexamine the data and alternative solutions to determine if there is a better solution. This may include additional target development. If the targeteer finds it is not possible to satisfy the stated objective (within reasonable bounds), the commander should be informed. The decision maker then can modify the objective or accept less than the expected results in the original plan. Ongoing testing of performance against objectives is an integral part of the targeting function and must occur in order to keep the decision maker informed and to help decide how future efforts will be applied.

7.3.2.2. The outcome is an initial flow chart or matrix showing the sets of aircraft or other forces assigned against one target. Each set is given a mission number. The unit, aircraft or weapons platform, weapons loads, and times-over target (TOTs) as well as, specific target aimpoints are also assigned to the mission. The flow chart may also identify the groupings of missions which can mutually support one another; that is, act as a mission package.

7.3.2.3. Tentative Package Development . To complete the mission packages framed in force assignment, planners conduct package development. Combat Plans assign the non-attack mission platforms ((i.e., air-air, Suppression of Enemy Air Defenses (SEAD), jamming, airborne control, tactical reconnaissance, air refueling, and CSAR aircraft)) which support the package ingress and egress. Planners next ensure the mission packages are deconflicted with other mission packages. This is accomplished primarily through the use of the Airspace Control Order (ACO).

7.3.3. Recommend Targets, Forces, Weapons, Fuzing, and Assessment Criteria. Targets, delivery systems, weapons, fuzing, aim points, and assessment criteria are presented to the operations staff. Targeteers must provide much more information to the operations staff than just a list of targets. After making the recommendations, targeteers and operations planners must work closely to adjust the recommendations as necessary. Presentation is important. Format should be tailored to the decision maker and staff present. The only constant is the targeteer must be ready to address the significance of the target list and know the munition effects of the recommendations.

7.3.4. Adjust Recommendations. Because the information available is fluid, when operations planners apply specific sorties to specific targets, the recommended plan may need adjusting. The targeteer, who should be readily available to assist, can best evaluate the impact of changes upon the entire targeting effort. The targeteer must also be aware of changes to update analysis calculations and projected results.

7.3.5. Present Joint Recommendations to Decision Maker. The targeteer must be able to present a comprehensive briefing on the recommended plan that explains the reasoning behind the target selection. If the analyst has prepared a thorough analysis of the target system and has good documentation, it should be easy to prepare a briefing. Generally, operations and intelligence each brief a portion of the recommended plan.

Chapter 8

EXECUTION PLANNING

8.1. Overview. This planning is necessary to prepare for attack after force application recommendations have been approved by the commander. It includes monitoring the execution of air operations. In a highly complex warfighting environment, a great deal of planning is required to execute operations effectively. This phase is almost administrative in nature as plans are finalized and materials gathered. Conceptually it also includes "thinking about doing." It is here the planning work to put "iron on target" (or any other weapon for that matter) is brought into the reality of an actual mission.

8.1.1. Execution planning begins after the commander approves the force execution recommendations. It occurs at both the operational and tactical level. The functions of targeteers during this phase depends on the level they are working.

8.2. Execution Planning at the Component Level. At the component level, execution planning generally consists of the following steps:

- Prepare inputs for ATOs, operations orders, or plans.
- Determine target materials and mapping, charting, and geodesy (MC&G) requirements for tactical units and ensure support in these areas is provided.
- Prepare for execution monitoring.
- Prepare for combat assessment.

8.2.1. Preparing Inputs for ATOs, Operations Orders, or Plans . The approved course of action is translated into information and tasking for those who will execute the plan. ((Refer to the JCS *Joint Operational Planning System* (JOPS), Volumes I and II, and AFM 28-3, *The USAF Operation Planning Process,* for formats and procedures used in preparing plans to support JCS tasking and USAF unilateral plans)).

8.2.1.1. The ATO may or may not be published in one message or at one time, depending upon command policy, directives, and the situation. The ATO must include the information required by subordinate units and be understandable. Targeting and operations personnel work together in preparing the ATO (filling in the required information into a fixed format text).

8.2.1.2. Target information should include: the basic installation identification elements (BE number, functional classification codes, target name, target coordinates, and country code); graphic references (i.e., imagery references or prepared graphics); a textual description of the specific aimpoint; recommended munitions and fuzing. When required for the weapon system; source, accuracy, or validity of the target coordinates should be included.

8.2.2. Support to Operational Units. A review and determination is made for what target materials and maps and charts are available for each unit to carry out command decisions. During target development the lack of adequate target materials should be documented and production requests submitted. During execution planning the requests should be reviewed and unit support functions notified of discrepancies. Potential requirements must be identified as early as possible so that target materials will be available at the wing and squadron level when it is time to execute an operation. Although there is the Shared Production Program to build and preposition target materials to cover most situations, it is not possible or cost-effective to cover all contingencies. Good planning can help prevent unexpected target material requirements from outstripping stockpile or production capability. Current efforts to utilize advances in digital technology and products should also alleviate problems being encountered with hardcopy materials.

Foot Stomper Box. When doing this phase of targeting the most overlooked task is to plan execution monitoring. Do not go straight from publishing the plan to monitoring its execution. Plan to react. Be situationally aware. Check how the enemy is reacting to current operations. Make sure the weather and maintenance is up to expectations. Do some "what if" thinking. Once the ATO is being executed it is too late to step back, review what the commander wants to do, and how that particular ATO impacts the enemy and supports objective achievement

8.2.3. Preparation for Combat Assessment. The time to begin thinking about assessment is before mission execution, not afterwards. This ensures the right people and resources have the tasking orders and other information required to support combat assessment. It involves determining assessment objectives and adjusting or establishing requirements. A full understanding of the sub-assessments of combat assessment presented in the next chapter are essential. Again this illustrates the targeting process is a conceptual construct and not always a step by step process.

8.2.3.1. Determining Assessment Requirements . Five questions to help determine requirements.

- What information is required? (objective fulfillment)
- From which sources will information be available in the required time frame? (collection management)
- When is the information required and how soon can it be obtained? (timing and sequencing)
- Who requires the information and how is it best presented? (AOC organization/ C2 structure)
- What efficiencies can the targeteer add to the production requests? (munition effects and signatures)

8.2.3.2. Establish Requirements . Using answers derived from the above questions, the targeteer can develop the requirements needed for combat assessment.

8.2.3.2.1. Information on target significance is critical, the target system, and how they impact the objectives and guidance are critical. Subsequently, the choice of source usually depends on how much time is available. If the decision to restrike must be made within minutes or hours, two primary sources of information are reports from the crew or forward air controller (FAC) and near real time sensor collection. If more time is available, other sources of information can be used, such as processed imagery. Only for very significant targets does the assessment of munitions effects require real time information. Of course, in accomplishing this task, collection and exploitation requirements set earlier during the target development and weaponeering phases will need to be adjusted.

8.2.3.2.2. A requirement must also be set up to designate the personnel, equipment, and facilities which will perform the combat assessment. In many cases, target analysts, imagery interpreters, and intelligence analysts will all be needed in this process.

8.2.3.2.3. In addition, distribution requirements must be decided for the combat assessment report. If the appropriate personnel do not receive the assessment, they may not have enough information in time for the commander and his or her staff. In this case, the commander may have to risk crews in restriking a target even though it has already been sufficiently damaged.

8.2.3.2.4. Information on any executed action cannot be attained instantaneously. Sensor, processing, analysis, and dissemination times need to be factored into execution monitoring planning. To use limited resources as efficiently as possible the weaponeering planning factors do not equal 1.0. Many attacks may not have the full physical damage expected or the target may simply be missed. Enough time must be allowed to get enough information to make a decision for diverts, and retargeting.

8.3. Execution Planning at the Unit Level. Execution planning at the unit level consists primarily of mission planning functions and mission folder construction. See chapter 10 for more detailed information.

8.3.1. Mission Planning . At the unit level, it is typical for there to be a mission planning cell whose entire job is build the mission folders. Generally, this cell will include aircrew, targeteers, and intelligence analysts. Each person contributes to the mission planning in their area of specialty. Every unit performs this function slightly differently, however, to meet their own unique mission requirements. Targeteers need to be well aware of their own unit's uniqueness.

8.3.2. Mission Folder Construction . Routes are planned considering package timing, tankers, and threat This goes into the mission folder. This folder contains all of the key information needed by the aircrew to perform the mission. MCR 55-125 outlines the specifics of what a mission folder should look like. In general, the folder will contain ingress & egress routes, radar predictions, weapons data, and target data, to include strike procedures. This is a vital document. Errors here may, at a minimum, mean mission failure, or, in the worst case, cause the loss of lives.

8.3.3. Reporting Preparation and Mission Support . Two other significant tasks unit level personnel accomplish during execution planning are reporting preparation and mission support. Targeteers support BDA reporting by their knowledge of weapon effects. They can also support interpretation of cockpit videos if the videos capture weapon impact and detonation. The target materials prepared for each mission provide debriefers an invaluable reference in debriefing aircrews. Another important aspect of unit level support to execution planning is the determination of mission support requirements. These requirements include all of those things which will be needed during combat operations and may be difficult to acquire (e.g., key maps and charts, imagery, target materials, basic supplies). It is imperative that targeting personnel ensure that they have an adequate stockpile of these. A good relationship with headquarters targeting personnel and the target material producer may yield great benefits.

Chapter 9

COMBAT ASSESSMENT

9.1. Overview. Effective campaign planning and execution require a continuing evaluation of the impact of combat operations on the overall campaign. Combat assessment (CA) evaluates combat operations effectiveness in achieving command objectives and recommends changes to tactics, strategies, objectives, and guidance. It has several sub-assessments including MA, BDA, and MEA. The military end state, as written in the campaign estimate and modified during an operation, is directly linked with CA. CA compares the results of the operation to the objectives to determine mission success or failure within the guidance parameters. More important than a review, it looks forward to determine if additional missions are needed and/or if modification to the objectives are necessary. The two pillars of combat assessment preparation are audience-awareness and prior planning. The desired outcome are a satisfied commander, staff, and operators. Combat assessment is one concept with many implementations.

9.1.1. Combat assessment examines lethal and non lethal strikes on the enemy (targets and target systems) to determine the effectiveness of operations. It answers the question: "How good of a job are we doing and what is next?" Combat assessment provides information to commanders, battle staffs, planners, and other decision makers. This wide audience complicates definitions and functions as applied across all components and joint staffs. Concept robustness is, therefore, all the more important for effective application. CA is focused on effectiveness not efficiency, (except to follow the military tenet on Economy of Force), and in order to be an accurate measure of effectiveness great care and significant effort should be placed on developing useful measures of merit to gauge effectiveness of the air campaign.

9.2. Who Is It For. Combat assessment tailors products for a particular C2 environment. CA belongs to the warfighter. As such it is the intent, or audience, of the assessments that molds the product. BDA has many uses and is the most visible product for combat assessment. It has the broadest audience. This overshadowing has unfortunately relegated the other assessments into obscurity. Munitions effectiveness assessment's audience includes the operators (e.g., aircrew, artillery crews), force packaging planners, and weapon logisticians and producers. Mission assessment's audience includes operational and strategic planners and commanders, both supported and supporting.

9.3. Where Is It Done. Combat assessment is done at all levels of the joint force (figure 9.1). The Joint Force Commander (JFC) establishes a dynamic system to support CA for all components. Normally, the joint task force J-3 will be responsible for coordinating CA, assisted by the joint task force J-2. The JFC and component staffs continuously evaluate the results of operations and provide these to the JFC for the overall evaluation of the current campaign. They must take into consideration the capabilities/forces employed, munitions, and attack timing in assessing the specific mission and operations' success and effects against the specific targets attacked, target systems/objectives, and remaining enemy warfighting capabilities, relative to the objectives and strategy. Future enemy courses of action and remaining enemy combat capabilities should be weighed against established JFC and component targeting priorities to determine future targeting objectives and recommend changes in courses of action. Although CA is listed as the end of the joint targeting process, it also provides the inputs for process reinitiation and subsequent target development, weaponeering, force application, force execution, and combat assessment. CA must be done jointly by targeteers, operators, engineers, and intelligence analysts. It is an ongoing, dynamic process that drives current and future targeting decisions. It is done to various levels of detail including near-term (e.g., diverts, alerts, targets of opportunity) mid-term (e.g., ATO cycle) and long-term (e.g., campaign phasing and analysis). It should come from all sources and be integrated into the battle management processes.

Figure 9.1. Levels of Combat Assessment.

Combat Assessment Covers All Levels

Level of Warfare	Assessment Criteria	Assessment Types
Campaign – Strategic	National & Theater Objectives/Guidance	Campaign CA Mission Assessments
Components – Operational	Missions, Objectives, & Measures of Merit	Component CA Mission Assessments Battle Damage Assessment Munitions Effectiveness
Combat Units – Tactical	Missions, Objectives, & Tasking Orders	Unit CA Mission Assessment Munitions Effectiveness Battle Damage Assessment

9.3.1. Combat assessment is the purview of the warfighters. CONUS organizations have the best resources to exploit peacetime intelligence. However the very large volume of theater intelligence and operational data developed during wartime is unavailable to CONUS organizations in its original form and timing. The majority of the data is in the theater after operations commence. Specifically; aircraft weapon video, mission reports, operational reports, situation reports, tactical reconnaissance, UAVs, JSTARS, and some U-2 data. These are the important sources of combat assessment. Moreover the commanders' responsibility and intent reside only with them in theater.

9.3.2. Components provide their own CA up the chain of command, laterally to supporting commands, and to those they are supporting. Tactical units do not often produce their own complete CA but provide input through their mission (air) and operations reports for BDA, MA, and MEA. As an example, Special Operations participates in combat assessment through debriefs of SOF after missions are completed. Mission success is gauged by whether the targeted enemy facilities, forces, actions, and/or capabilities were affected as desired. A review of battle damage assessment (for DA missions) is critical to the JFC and other components who can change the course of action or order restrikes in response to the current operational situation.

9.3.3. Combat assessment includes three principal sub-assessments: Battle Damage Assessment (BDA), Munitions Effectiveness Assessment (MEA), and Mission Assessment (MA). Battle Damage

Assessment is the timely and accurate estimate of damage resulting from the application of military force, either lethal or non-lethal, against a predetermined objective. Munitions Effectiveness Assessment details the effectiveness of the munitions damage mechanisms and the delivery parameters. Mission Assessment addresses the effectiveness of operations for tasked or apportioned missions.

9.4. Battle Damage Assessment (BDA). BDA is the timely and accurate estimate of damage resulting from the application of military force, either lethal or non lethal, against a predetermined objective. Battle damage assessment can be applied to the employment of all types of weapon systems (air, ground, naval, space, IW, and special forces) throughout the range of military operations. BDA is primarily an Intelligence responsibility with required inputs and coordination from Operations. Battle damage assessment is composed of physical damage assessment, functional damage assessment, and target system assessment (figure 9.2). BDA is the study of damage on a single target or set of targets. It is used for target study and target system analyses, reconstitution estimates, weaponeering, database updates, and for deciding restrikes. BDA was previously known in the air-to-surface arena as "bomb damage assessment" which still retains its own definition in JCS Pub 1-02. The BDA process answers the following questions:

- Did the weapons impact the target as planned?
- Did the weapons achieve the desired results and fulfill the objectives, and therefore purpose, of the attack?
- How long will it take enemy forces to repair damage and regain functionality?
- Can and will the enemy compensate for the actual damage through substitution?
- Are restrikes necessary to inflict additional damage, to delay recovery efforts, or attack targets not successfully struck?
- What are the collateral effects on the target system as a whole, or on other target systems?

9.4.1. Physical Damage Assessment . A physical damage assessment is an estimate of the extent of physical damage to a target based upon observed or interpreted damage. This post-attack target analysis should be a coordinated effort among combat units, component commands, the JTF, the combatant command, and national agencies. Some representative sources for data needed to make a physical damage assessment may include the following: mission reports, imagery, weapon system video, visual reports from ground spotters or combat troops, controllers and observers, artillery target surveillance reports, SIGINT, HUMINT, IMINT, MASINT, and open sources. The unit that engaged the target initially assesses physical damage and may recommend an immediate reattack before sending the report to the appropriate BDA cell for further analysis. Tactical objectives can be compared to the levels of physical damage achieved to identify any immediate problems with force employment (e.g., MEA) or to identify any requirements for reattack.

9.4.2. Functional Damage Assessment . The functional damage assessment estimates the remaining functional or operational capability of a targeted facility or object. Functional assessments are inferred from the assessed physical damage and include estimates of the recuperation or replacement time required for the target to resume normal operations. This all source analysis is typically conducted by the combatant command, in conjunction with support from the national-level assets. The combatant command BDA cell integrates the initial target analyses with other related sources including HUMINT, SIGINT, and IMINT. BDA analysts then compare the original objective for the attack with the current status of the target to determine if the objective has been met.

9.4.3. Target System Assessment . Target system assessment is an estimate of the overall impact of force employment against an adversary target system. These assessments are also normally conducted by the combatant command, supported by national-level assets, and possibly other commands which provide additional target system analysis. The combatant command fuses all component BDA reporting on functional damage to targets within a target system and assesses the overall impact on that system's capabilities. This lays the groundwork for future recommendations for military operations in support of operational objectives.

Figure 9.2. Battle Damage Assessment Example.

The following example of an attack on a headquarters building illustrates the processes described above. Initial physical damage assessment indicates 40 percent of the west wing of the building sustained structural damage. Functional assessment subsequently reveals sensitive communications equipment located in this wing was damaged to the extent that command and control activities have ceased. Assessing the effects of the attack on the target system, it was determined the loss of command and control from this headquarters severely degraded coordination in the forward area requiring subordinate commanders to rely on slower and more vulnerable means of communication.

9.4.4. BDA must be tailored to the decision maker and phased into the planning and execution cycles. Inputs into assessments must be planned and scheduled. Theater tactics, techniques, and procedures manuals must include assessment timelines. Instantaneous ground truth is impossible. Availability of selection and collection and assessment times must be anticipated in planning. Comprehensive BDA requires too much time even in a perfect world. This fact drives the phasing of BDA. The time phases should, therefore, correspond to the planning cycle. **Table 9.1.** illustrates BDA in air-to-surface operations.

Table 9.1. Air-Surface Damage Assessment Matrix.

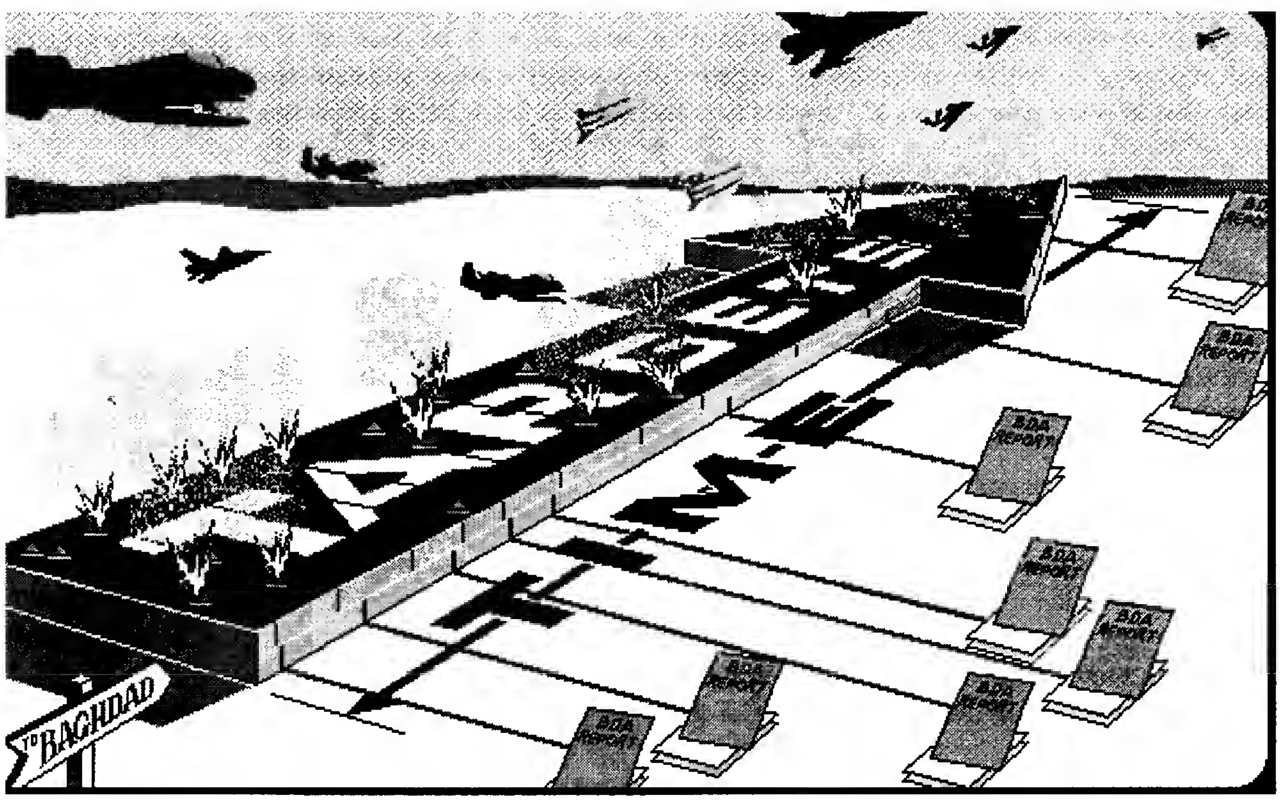
Air-Surface Damage Assessment Matrix(Who We Supply CA/BDA To)				
Phase	**1**	**2**	**3**	**3**
~ **Time** (see Note)	<24 Hours	1-3 Days	4 Days - Weeks	4 + Days-Weeks
Decision Cycle	ATO Execution	ATO Generation	Air Operations Planning	Theater Campaign Planning
Decision Aids	Raw Intel Mission Reports 1st Phase Reports Databases Target Materials Some Images	Fused Intel Mission Reports 1-3 Phase Reports Databases Target Materials Images	Intel Analysis 1-3 Phase Reports Databases Target Materials Strike Histories	Intel Analysis 1-3 Phase Reports Databases Target Materials Components' Assessments
Decision makers	Combat Operations	Combat Plans	Long Range Plans	JF-CINC/J3
Location	Air Operations Center			JF HQ

Supporting Intelligence Organizations	JFACC/Other Components Minimal Image Nat Supt Theater Assets	Theater Assets National Assets	JICs National Agencies	JICs National Agencies

NOTE: The time phases listed are intended as a conceptual guide, i.e., generally phase 1 reporting is used to guide combat operations; phase 2 for ATO generation timelines. The Matrix shows that time frames most impact the ATO cycle, not necessarily the times used in intelligence reporting. JP 2-01.1 does not use these time frames for BDA purposes.

9.4.5. BDA strike histories are important and must be kept for air delivered munitions. The fact that several strikes hit a target before a report is produced, or several reports from different sources are produced after one strike complicates the analysis process. Report source(s) also impact assessments over time (figure 9.3).

Figure 9.3. Target and Time Arrow.



9.5. Munitions Effectiveness Assessment (MEA). MEA is the function that weaponeers, engineers, and operators use to analyze the effectiveness of the munitions damage mechanisms and the delivery parameters. Essentially there are two types of MEA, short-term feedback for the operators, and long-term analysis for the weapons development and acquisitions communities. MEA includes:

- Recommending changes in methodology, techniques and tactics, fuzing, or weapon selection to increase effectiveness.
- Guiding imagery interpreters and intelligence analysts in conducting their analysis.
- Recommending development of new weapon capabilities and techniques.
- Determining problem areas in the employment of weapons.

9.5.1. MEA includes both the munitions data and the weapon platform delivery conditions. It is performance-based therefore comparisons between expected performance and actual performance are appropriate. Two central questions to ask are:

- Were actual delivery parameters similar to those expected?
- Were there any unanticipated operational limitations?

9.5.2. In wartime, MEA is the most often overlooked portion of combat assessment, but has the highest payoff for weapons and tactics development. Collection of delivery parameters must not be overlooked in contingency operations and takes few resources beside forethought. In peacetime this data is collected and incorporated into the Joint Munitions Effectiveness Manuals (JMEM) and other service and platform specific products. These manuals include methodologies from target acquisition and delivery parameters to weapons effects. The Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) manuals were developed to provide tri-service-approved and accepted data and methodologies to permit standardized comparison of weapon effectiveness. This means, in a practical sense, a Department of Defense planner in the Pentagon, a Navy weapons officer on the *USS Carl Vinson*, and an Air Force targeteer in Korea, should be able to draw essentially the same conclusion about Mk 82 general-purpose bomb effectiveness against Fan Song radars and have standardized data available for use in weapons procurement, stockpile decisions, or development of force employment options. On 14 December 1963, the Joint Chiefs of Staff asked military services to develop a joint manual that would provide effectiveness information on air-to-surface non nuclear munitions, and they named the Army as executive agent. The resulting coordination drafts of the *Joint Munitions Effectiveness Manual for Air-to-Surface Non nuclear Munitions* (JMEM A/S), as prepared by the JTCG/ME, were reviewed by the Office of the Secretary of Defense, the military services, and the Defense Intelligence Agency. These manuals have been continually updated and are now being converted to hypertext documents to speed weaponeering.

Foot Stomper Box. There is a new term, and a very useful one, that may be included in the future as a subset of MEA, Bomb Impact Assessment. The explosion in the number of drop-and-forget munitions such as the Joint Direct Attack Munition (JDAM) has expanded the need for a new mechanism or technological technique(s) to answer the most basic of questions. Bomb (munition) Impact Assessment answers three simple questions; 1) Did the bomb hit its desired impact point? 2) Did the bomb detonate high order? 3) Did the bomb fuze function as intended? These few questions, if answered, take much uncertainty out of operational assessments given the known JMEM probabilities of effects.

9.6. Mission Assessment (MA). MA addresses the effectiveness of operations for tasked or apportioned missions. While battle damage and munitions effectiveness assessments address force employment against individual targets and systems, MA evaluates a tasked mission such as interdiction, counterair, or maritime support. It directly impacts the JFACC's apportionment nominations and the resultant JFC's decision. Mission assessments are made by the supported commander.

9.6.1. The cumulative damage to targets does not represent the total effectiveness of the operation because it does not account for the intangible effects on enemy activities, for the effectiveness of non lethal force employment, or for enemy alternative courses of action. There are also many other factors to consider; the enemy rate of supply and resource consumption, enemy mobility, use of reserves, cushion, availability of repair materials, reconstitution or recuperation time and costs, plus the status of defenses. Additionally, mission assessment examines the effectiveness of tactical considerations such as tactics, penetration aids, and enemy and friendly countermeasures.

9.6.2. MA answers the questions outlined below. Answers to these questions help determine the effectiveness of the operations to meet mission objectives:

- Is the assigned mission's operations achieving command objectives and intent?
- Do the objectives require modification?
- Do the missions' level of effort require modification for that phase of the operation?
- How effective were operations in terms of impacting the enemy's actions or capability?
- What specific changes in combat operations would improve friendly efforts to degrade the enemy's will and capability to wage war?
- Does a particular enemy target system require more, or less, emphasis in future combat operations?
- Were there any unanticipated operational limitations?
- Were there any unintended consequences of the operation; that is, did strikes achieve some bonus damage or inflict undesirable collateral damage?

9.6.3. The mission is successful if the enemy is reacting as intended. MA's inputs come from internal and external sources. The measures of merit (effectiveness) are not common for all missions. Different missions require organizations to tailor responses for the process level in which they are involved. Some examples follow.

9.6.4. Major inputs for Close Air Support (CAS) mission assessment come from the Air Support Operations Center "bean counts". This is passed to the AOC by the CAS Summary Message (CASSUM). This is not a true assessment. The ground component commander is the primary decision maker for CAS mission assessment since he is the supported commander. His assessment in turn is used to identify possible target systems for air support.

9.6.5. Defensive Counter Air (DCA) mission assessment inputs flow throughout the Theater Air Control System. DCA mission assessment is primarily an Operations decision of the Area Air Defense Commander, if appointed. Intelligence inputs come from mission debriefs, the threat, and a solid knowledge of enemy tactics and capabilities. When blended with the JFACC's goals and strategies these provide the basis for a DCA apportionment recommendation.

9.6.6. Strategic Attack mission assessment is easy in a macro sense. Total enemy capitulation equates to 100 percent effectiveness. However, it is difficult, at best, to determine how an enemy perceives any threat or risk to himself. Does he calculate the threat using statistics and probabilities based upon actual observed threat? Does he perceive a threat in vague general terms without detailed analysis or statistical evaluation of its actual magnitude? Does he care about destruction of his economic infrastructure compared with the bigger issues of power or ideology? If an enemy can be made to perceive a particular course of action is hopeless, his behavior can be channeled into another direction. Enemy perception of a great threat or high risk is as important as the actual threat.

9.6.7. Interdiction mission assessment is based on its impact to the enemy force's capabilities, not just how many trucks or bridges are destroyed. For example, if the enemy believes they will suffer unacceptable losses in resupplying his forces through route A, they may begin to move supplies through route B which is longer and requires more transit time. In effect, the enemy will be delayed and his timetable disrupted, which can be a measure of success for the interdiction operation. The quantities of supplies reaching the enemy forces at the forward edge of the battle area (FEBA) has historic significance in the outcome of battles and should be considered one of the main measures of effectiveness. Unfortunately, this quantity is extremely difficult to measure. Reduced levels of fighting (changing from offensive to defensive operations) is another measure of effectiveness.

9.6.7.1. Duration of individual choke point closure caused by interdiction appears to offer one reasonable surrogate measure of enemy resupply capability. Another may be counting trucks passing clandestine sensors along roads (the Vietnam Era IGLOO WHITE program did this). This is costly but it can be coordinated with strikes to destroy vehicles. Trucks "reported" destroyed through MISREPs is probably the poorest method used in analysis. (There are varying degrees of destruction or damage and uncertain excess transport capability.)

9.6.7.2. Another way to assess interdiction results is to measure post-offensive buildup in the first few days, weeks, or months after an operation. Rate and type of resupply and reconstitution are indicators of what the enemy would like to do and of the damage sustained.

9.6.7.3. There are at least three measures of very little use in analyzing interdiction effectiveness; namely, sorties flown, bombs dropped, and days in combat. Unfortunately General Schwartzkopf said this is what he had to do during the Gulf War.

9.6.7.4. Two factors stand out in all interdiction analysis. First, large ground force campaigns without deep interdiction are less effective than a coordinated operation including both. Conversely, a deep interdiction campaign without coordinated ground operations to increase the enemy's supply consumption would be less effective than a coordinated campaign. Second, it is the enemy's behavior or activity which must be modified. Destruction of individual targets and the resulting "body" count, as an effectiveness measure contributes little to the overall objective. It is the activity that must be attacked or struck. It is the effectiveness of the attack on the activity that must be measured.

9.7. How It Is Done. All objectives should have measures of merit developed during the planning phase and refined in the target development process in an iterative fashion. Intelligence assists the commander in determining when objectives have been attained so joint forces may be reoriented or operations terminated. Intelligence evaluates military operations by assessing their effect on the adversary situation with respect to the commander's intent and objectives, and those of the adversary. The intent is to analyze with sound military judgment what is known about the damage inflicted on the enemy to try to determine: what attrition the adversary has suffered; what effect the efforts have had on the adversary's plans or capabilities; and what, if any, changes or additional efforts need to take place to meet the objectives. CA requires constant information flows from all sources. However, the same basic information is generally collected for all assessments. The information (data) gathered for mission assessment is similar, and in many instances the same, as collected for battle damage assessment and munitions effectiveness assessment. A collection plan, tailored EEIs, and the objectives' measures of merit are required to do the assessment. The JFC apportions joint force reconnaissance assets to support the CA intelligence effort that exceed the organic capabilities of the component forces. The component commanders identify their requirements and coordinate them with the joint force J-3 or designated representative. CA differs from wartime to contingency operations. The closely held nature of some contingency operations has led to badly coordinated collection plans. Very specific EEIs should be developed. Intelligence analysts and collectors must be knowledgeable of the targeting objectives, weapons, timing, and targets.

9.7.1. There are many different measures of merit, an example of one follows, from a general component objective down to a specific measure of merit :

- Achieve Air Superiority
- Deny Enemy Air EW and GCI support
- Degrade Air Defense Network by 75%
- Destroy SOCs I, II, III
- Enemy Air Intercepts non-existent/non-effective

9.7.2. Information must get to the right offices. The ATO must be disseminated to the imagery interpreters to provide them numbers and types of weapons along with the desired point of impact. The ATO must also be distributed to other intelligence analysts (e.g., SIGINT, MASINT, HUMINT) for time-over-target and aimpoints. A good example is the SEAD mission, especially anti-radiation missile operations that must be coordinated with the SIGINT collectors to the extent possible.

9.7.3. Intelligence contributes to the mission/strike cycle function of assessment. Assessment can either be inductive (using sensors or aircrews to directly observe damage inflicted) or deductive (using indirect means to ascertain results). Examples of inductive observation could involve secondary explosions seen by the aircrew or movement stopping after attacks. Assessment can be deduced if damage is unobserved but verified by third party sources. Indirect bomb damage assessment can also be inferred from the miss distance (the distance between weapon detonation and the target). A measure of success of the attack is the impact on the activity the enemy is performing through the respective target system. Qualitative assessment should be used in addition to quantitative analysis. Single methods of measurement should be avoided, because they may lead to unsound or distorted results.

9.7.4. Time impacts CA and the functions an organization performs. Component force headquarters are concerned with near-term and mid-term combat assessment for the majority of their work. This of course leaves out the long range (strategic) planners at the components. The current operations targeteer and Intelligence analyst maintain a continuous awareness of the battle situation, the targeting objectives and near-term combat assessment in order to provide the best recommendation to the battle managers. The targets branch usually contains the Combat Assessment Cell. This cell of targeteers and other disciplines provides the main fusion center for near term and mid-term (component) into combat assessment. It also provides the inputs for collection requests across the spectrum of combat assessment. It is the focus of all intelligence inputs to combat assessment. It is responsible for managing inputs to, coordinating, and analyzing combat assessment information and its distribution to decision makers and other users. Requirements for most long-term assessment studies will be generated at the theater. Theater wide intelligence producers such as Joint Intelligence Centers provide their studies and analysis to the joint force commander and to lower and higher echelons. JCS/J2T and DIA will normally be the national level focal point for input into long-term combat assessment.

Chapter 10

TARGETING FUNCTIONS AT THE COMBAT UNIT LEVEL

10.1. Combat Intelligence Functions at the Unit Level. Most unit level intelligence organizations are composed of two branches--operational intelligence (also termed "combat" intelligence) and target intelligence. Each performs a specific function:

10.1.1. Operational intelligence keeps the commander and aircrews informed of intelligence matters needed to perform the mission. It maintains intelligence database holdings, provides briefings and training, and helps with mission planning.

10.1.2. Target intelligence assembles and maintains mission or planning folders with related target planning documentation.

10.2. Unit Level Targeting Functions. Five important target intelligence functions are performed at the unit level:

- Mission planning
- Mission folder construction and maintenance
- Aircrew target study and certification
- Debriefing, battle damage assessment, and intelligence reporting
- Identification of unit support requirements (including identifying, requisitioning, and safeguarding target materials for combat and training missions).

10.2.1. Targeteers also perform normal administrative functions such as updating and posting changes to publications, classified document control and inventories, periodic aircrew or commander's briefings, and issue and control of classified training and mission target materials. The extent to which targeting personnel will be involved in these administrative functions depends on command policy for using targeting personnel, the desires and motivation of individuals, and the unit's mission and organizational responsibilities. Targeting functions at the unit level are critical to mission success, and unit targeting personnel are vital to mission planning and provide the link to the targeting branch at the air operations center. Targeting personnel must be mission-oriented, highly motivated, and involved in unit activities. In the course of performing their duties, they must:

- Work closely with planners from Standardization and Evaluation (StanEval), weapons and tactics, training, and scheduling. They must be thoroughly familiar with all aspects of mission planning, tactics, and weapon system characteristics and capabilities.
- Think in terms of aircrews and the mission. Their primary concern must be what the aircrews need to accomplish their mission.
- Identify deficiencies in targeting support for the aircrews from higher headquarters and help to devise solutions to the problems identified.

10.3. Mission Planning. Targeting personnel at a unit are generally intimately involved in the mission planning process. It involves the selection of optimum routes and profiles under fixed criteria considering all related aspects of ingress, weapon delivery, escape, and egress; and delivering a weapon on target is the primary objective of mission planning and execution. The Air Force Mission Support System (AFMSS) is being used at the unit level to automate this process.

10.3.1. Mission Components. A mission is typically divided into four parts: ingress, initial point (IP) to the target or weapon release point, escape, and egress.

10.3.1.1. Ingress can be planned for high or low level flight, with fuel consumption and enemy defenses primary planning considerations. At low altitudes, the aircraft may be less vulnerable to some types of enemy defenses, but fuel consumption is greater. At higher altitudes, the aircraft could be affected by radar guided and other defensive systems but requires less fuel. Aircrews make navigation and weapons systems checks during this portion of the mission, and in some cases weapon programming and pre-arming are also completed.

10.3.1.2. From the IP to the target, the aircrew acquires the IP, establishes run-in speed and heading, makes final determination of target area tactics, identifies reference points which will assist in target acquisition (final check points, offset aim points, etc.), and prepares or activates weapons or ordnance for release.

10.3.1.3. The escape phase of the mission begins immediately after weapon release and continues until a predetermined point, or adequate time or distance, from a target is reached.

10.3.1.4. Egress begins where the escape ends and continues until post strike base (PSB) recovery.

10.3.2. Route Planning Priorities. Three general route planning priorities guide mission planning: delivery of the weapons on target; survival of the aircrew; and recovery of the aircraft. A well-planned route will allow for a higher probability of success for all three. This planning must also consider how to avoid friendly weapon detonations, use acceptable reference points for navigational positioning, avoid enemy defenses, use reentry corridors, consider fuel minimums, and provide mutual defense support. These criteria are outlined in Air Force Instructions and supplemented by commands based on their specific requirements.

10.3.3. Profile Selection. There are two types of mission profile reference terms: high (H) and low (L). Weapon system capabilities and characteristics, reference point and target identification, and enemy defenses are primary considerations for deciding which profile or combination of profiles to use. For example, a profile could be divided into three sections, each represented by a single letter--H-L-H. The first letter represents a high level ingress. The second letter indicates a low level entry point--either an arbitrary point or the initial point--and continues through the escape to the start climb point. The third letter represents egress at high level. Missions are usually planned for both instrument flight rules (IFR) and visual flight rules (VFR).

10.3.4. Standard Planning Data. In most units, standard mission planning guidelines are developed by the unit StanEval section from aircraft technical orders. Standardized data might include airspeeds, climb schedules, let-down schedules, acceleration data, tank jettison data, programmed turn information, reference point selection criteria, orbit point data, fuel flows under various conditions, etc. Standard planning data must be used so unit planning and mission folder programs are uniform.

10.3.5. Mission Planning and Delivery Tactics . Missions may be either preplanned or immediate. In any case, there must be some degree of planning at the unit level. Usually, this is the execution planning portion of operational plans, because each unit is the most knowledgeable of its own capabilities.

10.3.5.1. Delivery maneuvers and parameters for existing air-to-surface delivery systems (including operational sequences, system components, and component functions) are described in the *Joint Munitions Effectiveness Manual, Air-to-Surface Delivery Accuracy,* TH 61A1-3-3. Nonnuclear delivery techniques include visual manual delivery (level or dive bombing, loft or toss bombing, strafing, and rocket attacks); computer-aided visual delivery for targeting designated systems; radar bombing systems, both high and low levels; and air-to-surface guided weapon delivery Global Positioning System (GPS), Inertial Navigation System (INS), Terrain Contour Matching (TERCOM), TV-guided, semi-active laser-guided, remotely controlled weapons, radar-homing, and radiation detecting).

10.3.5.2. Nuclear delivery techniques are divided into two categories: strategic and tactical. Strategic delivery methods include "Short Look" and "Pop-up" (PUP) maneuvers. PUP is the normal planned delivery mode for bomber aircraft with operational terrain following equipment. The Short Look option is normally used only during IFR conditions or when terrain following navigational ability is lost. Tactical delivery methods include the loft over-the-shoulder, level release, laydown, and low angle drogue delivery (LADD) maneuvers. In all cases, weapon release altitudes and airspeeds are dependent on the characteristics of the weapon involved.

10.4. Mission Folder Construction. Prior to the fielding of AFMSS, many staff elements at the unit level helped prepare mission folders particularly with the target intelligence branch assembling the information and constructing the folder itself. The staff, frequently with aircrew participation, performed the actual "cut and paste" work with the charts, including informational overlays and data cards for rapid in-flight use, with necessary annotations. Typical annotations and overlays include Navigational Information Blocks or course arrow boxes that detail course, heading, airspeed, altitude, en route timing, etc; weapon data cards; route check point, turn point, target, and offset aim point (OAP) coordinates; and enemy defense information. This process is now performed by aircrews on an AFMSS machine with help from intelligence personnel. It is important that intelligence personnel remain involved since during an actual mission, with many different activities occurring simultaneously, aircrews need clear and concise information to achieve mission success. Refer to applicable Air Force Instructions and command supplements for detailed guidance on folder building procedures and quality control.

10.5. Aircrew Target Study and Certification. Combat mission folders with aircrew study materials are broken down into two sections: the Combat Mission Section (CMS), which the aircrew takes on the mission, and the Mission Planning Section (MPS), which provides expanded intelligence and operational data for crew study. The MPS can include information on weapon effects, limitations, and employment; route threat assessments; enemy air order of battle information; escape and evasion data; safe areas and overflown country briefings; target significance; and C2. Targeting personnel should be available to assist and support aircrews with additional information, materials, maps, charts, and graphics, as required.

10.6. Debriefing and Battle Damage Assessment. Targeting personnel generally do not debrief aircrews. They should, however, become involved with and support those who do.

10.6.1. Targeting personnel can insure the debriefers have suitable visual aids (maps, charts, target imagery) and target information (identification data, descriptions, aim points, objectives, etc.). The debriefers must know the mission background and details of the missions of other units having similar objectives. Furthermore, targeteers should review essential elements of information (EEI) questions to be used by the debriefers. While EEIs are included in command-prepared documents and regulations, specific targets may require additional EEIs. The debriefings also provide information on other targets and items of interest. All of this information should be given to the debriefers prior to mission execution.

10.6.2. Targeteers should ensure aircrews are informed of the results of their mission (munition effects or accuracy scoring) and should work with imagery interpreters and provide the same target materials, maps, charts, and intelligence given to the debriefers. Targeting personnel should be among the first to receive the results of imagery readouts.

10.6.3. Targeteers must work closely with aircrews and debriefers, as well as other intelligence specialists and mission planners from the operations staff in order to prepare timely and credible assessments. These assessments provide decision makers with information on the need to restrike a target or change munitions or tactics to improve mission effectiveness.

10.7. Ensuring Mission Support. Although higher headquarters should pass on necessary intelligence and procedural information to subordinate units, unit targeting personnel must ensure they have the information necessary to support their mission. If there are deficiencies, they must be promptly identified to the headquarters staff. Unit targeting personnel must also identify and resolve problems, limitations and constraints affecting targeting functions, as soon as possible. Target intelligence personnel also determine requirements, requisition procedures, stockpiling and control of maps, charts, graphics, and other materials needed to prepare target folders and support the unit mission. The branch usually acts as a source of supplies for unit target materials users, as well as librarian for Air Force and command directives and publications used to requisition target materials.

10.8. Developments in Unit Level Targeting. Because of continual advances and modifications in weapons systems and expected accuracy's, targeting data also must be constantly updated for completeness and accuracy. Advances in imagery have made it possible to develop highly accurate and reliable targeting information. For example, the Analytical Photogrammetric Positioning System, though relatively old, is still in use at the air component and command level to locate both target coordinates and precise reference point positioning. The new Digital Point Positioning Data Base (also imagery based) will provide even more up-to-date positioning capability down to the unit level.

10.9. Conclusion. The unit targeting function not only demands time and skill, but is challenging as well. With new concepts, programs, data, and equipment, new skills and techniques will have to be developed and adapted for unit use. Leadership, resource management, and coordination with other unit specialties are required to accomplish any unit mission. With continued improvements and changes in data collection, dissemination, usage, and the advent of new plans, procedures, and equipment, the target intelligence function will become not only more important at the combat unit level, but also more challenging to targeting personnel.

Chapter 11

TARGETING IN THE INFORMATION AGE

11.1. Information Operations (IO) and Information Warfare . Information is central to the way the U.S. wages war and will be critical to Air Force operations in the 21st Century. As Air Force doctrine changes to recognize air and space operations, targeting will transition leaving behind the old paradigms and institutionalizing info-oriented perspectives.

11.1.1. Department of Defense (DoD) Directive S-3600.1 updates IO and IW policy, definition, and responsibilities within the DoD. IW is a sub-set of Information Operations and is defined by the directive as "Information's Operations conducted during time of crisis or conflict to achieve or promote specific objectives over a specific adversary or adversaries." Information Operations is defined as "actions taken to affect adversary information and information systems while defending one's own information, and information systems." The goal of IW is to achieve the Air Force core competency of information superiority by successfully performing the missions of counter-information. Information superiority is obtained over an adversary by controlling the information environment, exploiting our advantage in information and information systems, and by using information to enhance our operations. IW employs a force-multiplier capability, enhancing and synergistically adding to other methods of warfighting.

11.1.2. Counter-information includes both defensive counterinformation (DCI) and offensive counterinformation (OCI). DCI consists of security measures (information assurance and information security), counterintelligence, counterdeception and counterpsychological operations (PSYOP). OCI consists of PSYOP, electronic warfare (electronic attack, electronic protections, and electronic warfare support), military deception, physical attack and information attack. During times of crisis or conflict (war), USAF IW activities must be integrated into the joint air and space operations plan and air tasking order (ATO).

11.1.3. The Air Force leadership (CSAF and SECAF) views IW as an emerging concept of great significance, as signified in the foreword of *"Cornerstones of Information Warfare":*

- "As information systems permeate our military and civilian lives, we are crossing a new frontier - the Information Age. It will define the 21st century and influence all we do as an air force. Information Warfare has become central to the way nations fight wars, and will be critical to Air Force operations in the 21st century. This means, of course, that today we must invest in our people, planning, equipment, and research so our ambitions can become reality. We will involve every Air Force person in this effort, generating a wave of momentum that will carry us into the next millennium."
- "Information Warfare is not the exclusive domain of the Air Force, or any other service. Information technology advances will make dramatic changes in how this nation fights wars in the future. They will allow a commander's vision and view of the battlespace to be shared at the lowest level. Because of this, every practitioner of the profession of arms has a responsibility to understand the impact of information warfare on their service. From our unique perspective as soldier, sailor, marine, or airman, we can then forge a common understanding of how to use information warfare to enhance joint warfighting capabilities."

11.2. Objectives. "*Cornerstones of Information Warfare*" and "Air Force Doctrine Document (AFDD)

2-5, Information Operations" discuss the three objectives of IW:

- Control the information realm so we can exploit it while protecting our own military information functions from enemy action
- Exploit control of information to employ information warfare against the enemy
- Enhance overall force effectiveness by fully developing military information functions

11.3. Challenges. As the Air Force recognizes the significance of IW, its impact will be felt throughout all aspects of Air Force intelligence. Unprecedented levels of detail, the identification of critical information elements contained throughout the spectrum of the target categories, and compressed collection timelines are expected to characterize the general direction of change. Targeting support to IW is a challenge and will require a collaborative effort across the operations, intelligence, and technical communities.

11.3.1. The ability to directly influence the information realm through Direct IW (Information Attack) requires an entirely new direction of intelligence support. Methods of collecting and analyzing the new types of intelligence necessary to plan and execute offensive and defensive aspects of this mission will need to be incorporated. Targeting and combat assessment functions will become increasingly complicated as they expand from their purely physical orientation to support warfare in the information realm.

11.3.2. The Air Force views information as a separate realm, potent weapon, and lucrative target. In looking at information as a distinctive realm, we are looking at expanding from the physical or material level to what is described as the virtual level; a layer without geographical constraints. Within the information battlespace, the means to achieve military objectives has now expanded. Not only can we target traditional force elements with precision, but we can hold at risk the architecture that orchestrates modern warfare. Information technologies will enable us to attack a significantly larger set of targets using enhanced lethal and non lethal capabilities, greatly complicating weapon system allocation decisions.

11.4. Information Warfare and the Targeting Process. The impact of IW is addressed in detail across the six phases of the targeting process: objectives and guidance; target development; weaponeering; force application; execution planning; and combat assessment.

11.4.1. Objectives and Guidance Derivation . The development and dissemination of objectives and guidance mark the first step in the targeting process and arguably the most critical. Targeting professionals must comprehend National Command Authority (NCA) IW objectives and guidance as passed to the Combatant Commanders. SECAF and JAG IW guidance must be followed and incorporated into IW actions. Targeteers should be intimately involved in the delineation of the cyberspace equivalents of fire control measures, (e.g., FSCL and Corps/Division boundaries) to ensure deconfliction and avoid fratricide. They also must become knowledgeable of Joint policy and doctrine for IW. Targeting support to IW should be included not only in Air Force documents as this pamphlet but also in joint documents such as Joint Pub 2-0, *Joint Doctrine for Intelligence Support to Operations* and in the forthcoming Joint Pub 2-01.1, *Joint Tactics, Techniques, and Procedures for Intelligence Support to Targeting.*

11.4.2. Target Development .

11.4.2.1. Intelligence must be readily accessible, timely, accurate and sufficiently detailed to support an array of DoD IO requirements, to include, research, development and acquisition and operational support. Detailed intelligence on the information systems and the IO doctrine likely to be employed by a wide range of adversaries must be provided. Essential Elements of Information (EEIs) which support the prosecution of an IW strategy against individual targets and as part of an overall campaign must be documented. Targeteers must work closely with the collection management community to develop and modify EEIs for IW. The following sample IW EEI's (figure 11.1) were developed in the Directorate of Research, Air Command and Staff College research paper, *"Information Warfare: An Opportunity for Modern Warfare":*

Figure 11.1. Sample IW EEIs.

- What is the IW Target description, location, significance?

-- What are its primary/secondary functions?

-- What type of information is used/processed/communicated by the target? How is this information received/stored/cataloged/transmitted/destroyed?

- What physical attributes does the IW target possess?

-- Number of structures (physical description and locations of each)

-- Layout of each structure (size, entry/exit points, room locations)

-- Construction and key components (materials, types of equipment)

-- Functional organization in each area (command, operations, maintenance, communications)

- What communications does the IW target use?

-- Type and parameters (telephone, TV, terrestrial radio, satellite, fiber, modulation type, waveform, frequency(s) and power)

--- Country of origin, year manufactured, model, frequencies

--- Methods and procedures for securing communications

--- System manning and operating procedures

--- Number of each type of device and location

--- Signal allocation, controlling authority

--- Radio/TV broadcast and newspaper (controlling agency, locations, operating procedures, political affiliation, etc.)

--- Visual signs used (flags, panels, lights)

--- Noise signals used (klaxons, sirens)

--- With whom does the target normally communicate?
--- Associated support facilities/equipment and their locations
--- Number and location of personnel
--- Internal and external links
--- Switchboard, relay towers, rerouting centers
--- Type/number/location of antennas, cables, microwaves, local/wide area networks, point-to-point, etc.

- What is the primary and alternate power supply?

-- Type, number, and locations
-- Associated facilities (transformers, relays, etc.)
-- Fuel supply (type, location)
-- Conduits (type, location)

- What on-site security is employed?

-- Physical security (guards, fences, vaults, passive/active detection systems, alarms etc.)

--- Location and type (guard posts, bunkers, trenches, etc.)
--- Physical description

---- Dimensions
---- Lighting (type, location, schedule)
---- Power source and location
---- Frequency/schedule for patrols or security checks

-- Physical security procedures

--- Patrols (type, size, patrol routes, armament)
--- Detection systems (cameras, ground/water/air alarms, electromagnetic, etc.)
--- Barriers and obstacles (type, size, locations)
--- Entry and exit procedures (key, cipher, personnel recognition, code words, etc.)

- What type of communications security and computer security are employed?

-- Type of security (cryptographic, physical access, hard wire, brevity codes, "sneaker" net)
-- Operating procedures

-- Cryptologic change schedule
-- Computer security

--- Type of security (physical, password, software monitoring)
--- Operating procedures

11.4.2.2. IO are conducted across the full range of military operations. The focus of IO is on decisionmaking and information-dependent systems, including weapons, infrastructure, command and control, computer and associated network systems. Developing an IW targeting strategy requires detailed intelligence and thorough analysis and planning to determine the best targets to achieve desired effects efficiently and effectively. Critical elements must be developed for information attack targets. Many target sets need to be reevaluated in light of the "information age" which has automated many functions of modern day facilities. Target system category classifications must be updated to facilitate analysis of IW considerations. DIA may need to update *"Critical Elements of Selected Generic Installations*" (DDB-2800-2-83 Chg 8, Aug 94) to identify critical information elements and information attack options. This document currently identifies the critical elements of selected generic or typical installations appropriate for attack by air-delivered conventional weapons and unconventional warfare (UW) operations; installations are identified by the category codes of the DIA *"Standard Coding Systems Functional Classification Handbook*" (DIAM 65-3-1, Jul 95). Each listing begins with a brief general description of the installation summarizing its function and physical characteristics, followed by a table identifying the critical elements and an estimated recuperation time for each critical element. A few examples identifying information "critical elements" are taken from a paper on notional critical target sets (figure 11.2) by Dr. Dan Kuehl from National Defense University, School of Information Warfare, titled *"Target Sets for Strategic Information Warfare in an Era of Comprehensive Situational Awareness"* and an Air University publication by Maj Steven M. Rinaldi, *"Beyond the Industrial Web, Economic Synergies and Targeting Methodologies."*

Figure 11.2. Notional Critical Target Sets -- Strategic Information Warfare.

Infrastructure

- Energy and power sources (both electric and POL)
-- Production centers
-- Transformer stations
-- Distribution nodes
-- Control centers for POL production and refining
-- Pumping stations
-- Backup systems

-- Example: Use intrusive IW to seize control of the computer-controlled valve network in a major POL refinery and shut down the flow of both unfinished and refined POL products. This would require physical repairs such as valve replacement to offset the effects of the attack, and the plant would remain hostage to a destructive attack using precision weaponry. This action would have impact ranging from military effects (interdicting the supply of refined POL products) through economic and social effects. Maj Rinaldi states "pipeline controls are electromechanical (relays) or solid state. The control network ties together all the elements of the pipeline system. Pipelines rely upon computerized supervisory control and data acquisition (SCADA) system for control and management functions. SCADA systems are used to control all operations and transmit information between dispatch control centers and remote terminal units at pipeline facilities. Manual work arounds to loss of SCADA, electromechanical controls might be extremely difficult to carry out."

- Information infrastructure
  - -- Telecommunications (radio & TV); public and secure switches
  - -- Radio relay facilities
  - -- Telephone exchanges
  - -- Fiber optic networks, nodes, and repeater stations
  - -- Microwave transmission networks and nodes
  - -- SATCOM links
  - -- Computer and data processing centers
  - -- National C3I centers

-- Example: use intrusive IW to override SATCOM dish controls and cause the dish to realign itself to a useless/unusable orientation. This would prevent our adversary from using its SATCOM capability without requiring US forces to engage in destructive actions.

Political

- Internal state police and control forces
  - -- Headquarters for internal control agencies ("secret police")
  - -- Intelligence collection systems (i.e. SIGINT intercept)
  - -- Databases supporting internal control systems

-- Example: Alter/destroy via intrusive IW the enemy's computerized database of suspected internal subversive elements. Follow up this action with an intensive PSYOPS effort aimed at dissident elements in the population; this could seriously undermine a totalitarian state's control over segments of its population, possibly threatening unrest or revolt.

- Financial centers and networks

  - -- Institutions (banks, trading centers, etc.)
  - -- Currency controls and depositories

-- Databases for financial management

-- <u>Example</u>: Electronically impose a UN-mandated quarantine of a rogue state's financial reserves; could prevent arms purchases or the leader from looting the national treasury and fleeing.

11.4.2.3. Many organizations are developing decision aiding software applications that have the ability to produce, as a final outcome, an installation (target) list. Examples include National Air Intelligence Center's Interactive Country Studies and Links and Nodes Telecommunications Databases; Air Force Information Warfare Center's SENSOR HARVEST; NSA's Adversary; and some Joint Warfare Analysis Center's products. The final products of these various applications must be able to interface with the targeting community's Rapid Application of Air Power (RAAP), the USAF standard targeting application and the joint standard Air Tasking Order targeting application within the JFACC environment. RAAP is the interface between targeting planners and the Advanced Planning System (APS) in CTAPS. This incorporation would enhance information operations supporting C2W/IW target system analysis and target list development. Automated target system analysis capabilities must be easily accessible by targeting personnel.

11.4.3. Weaponeering . Methodologies are needed to quantify the expected results from non lethal weapons for IW attacks on specific types of targets, similar to JMEMs, which provides kill mechanisms (blast, penetration, crater, fire), vulnerability data and damage criteria information for conventional weapons. Candidate IW employment concepts include the following: (Research paper; "Information Warfare: An Opportunity For Modern Warfare")

- Corruption - The alteration of information content; the manipulation of data to make it either nonsensical or inaccurate. Destroying existing knowledge.
- Deception - A specific type of corruption; the alteration of, or adding to, information to portray a situation different from reality. Creating false knowledge to include masquerading.
- Delay - The reversible slowing of the flow of information through the system, and the slowing of the acquisition and dissemination of new knowledge.
- Denial - The reversible stopping of the flow of information for a period of time; although the information may be transmitted and used within friendly territory, the adversary is denied access to it. The prevention of the acquisition and dissemination of new knowledge.
- Disruption - The reduction of the capacity to provide and/or process information (reversible). This is a combination of delay and corruption. The delay of the acquisition and dissemination of new knowledge and the destruction of existing knowledge.
- Degradation - The permanent reduction in the capacity to provide and/or process information.
- Destruction - The destruction of information before it can be transmitted; the permanent elimination of the capacity to provide and/or process information.

Each of the potential effects listed above have both desirable and undesirable attributes. While developing an IW strategy to employ these concepts, the planner must consider the potential impact of these attributes on achieving the overall objective. These attributes include:

- *Persistency* - How long will the IW strategy affect the target?
- Speed - How long will it take to achieve the desired IW effect?
- Latency - Can the IW tactic lie dormant within the target until needed?

- Reversibility - Is the IW effect reversible? Both reversible and irreversible effects can be desirable.
- Fratricide - Does the attack method cause unwanted effects on friendly systems?
- Collateral Damage - Will attacking the target cause collateral damage in other systems because of its linkage(s)? Will the method of attack cause unwanted effects on other systems?
- Stealth - How easily can an enemy detect the friendly IW strategy? Exploitation and corruption of the enemy's information must be accomplished in a manner which is not readily detectable. The effectiveness of the attack is obviously degraded if the enemy gains knowledge of it. (Note: In some cases, it may be beneficial to ensure the enemy knows the friendly information operation capability).
- Mutual Interference - Will attacking the target negate other information operations? If the information employment concept is designed to create a false reality, then one must allow the adversary to "see" or "hear" the false reality. Similarly, planners would not want to target a critical node which can be exploited and serves to enhance information available to friendly forces. This attribute, perhaps more than any other, affirms the need for a fully coordinated and integrated IW strategy concept.

11.4.4. Force Application . Targeteers will need to become versed in lethal and non lethal methods of attack available under IW, in addition to the more familiar conventional modes usually used. The varied methods of attack and weapons will require strict deconfliction between planning and operations personnel. Targeting staffs which will be generating the ATO/ITO will need to be responsible for integrating the IW campaign effort (**Table 11.1.**). HQ staff must push for appropriate levels of participation commensurate with this responsibility.

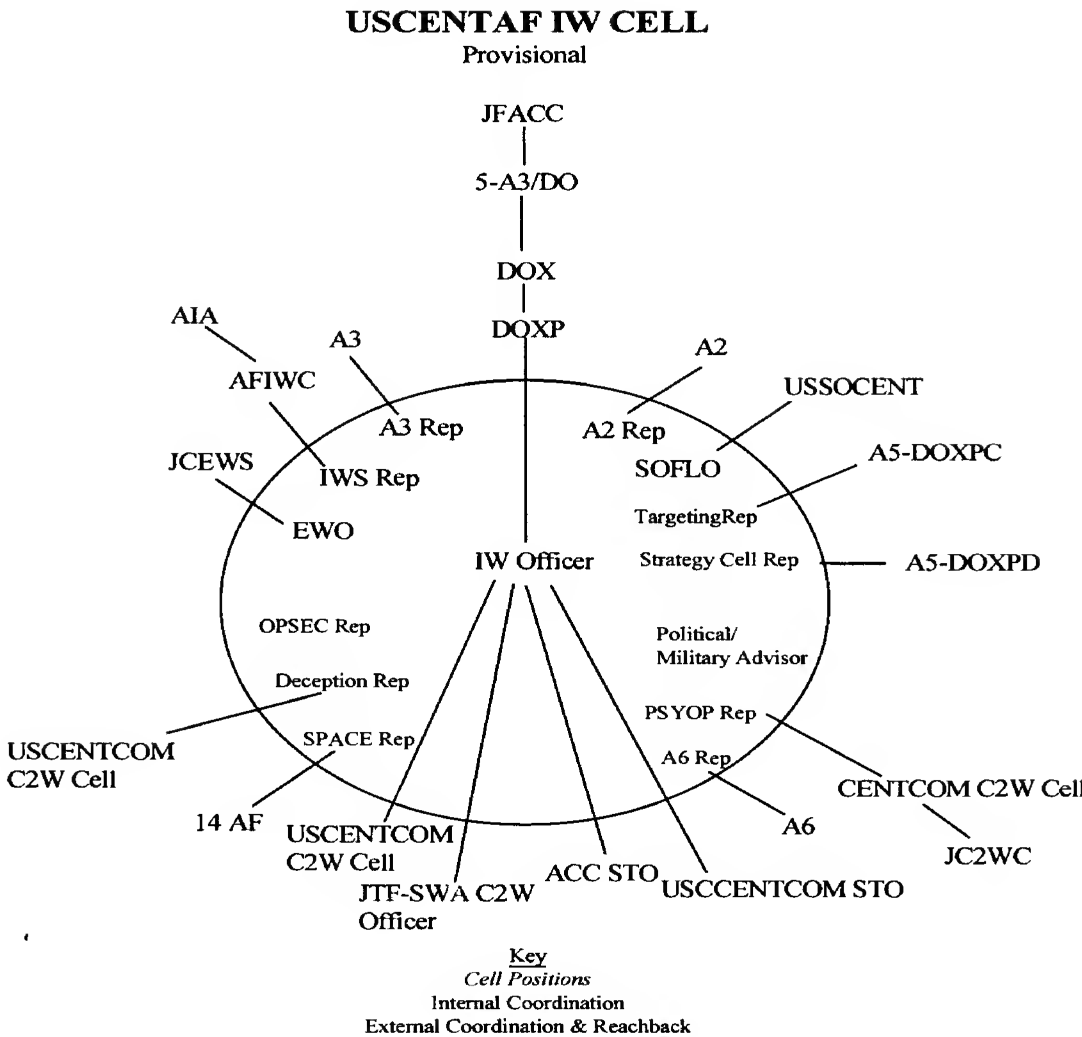
- Target development team members in the AOC for Information Warfare and Command and Control Warfare (IW/C2W) must be defined. The target development A3/A2 members in the AOC should be augmented as needed by members of the Air Force Space Support Teams (AFSST), Information Warfare Support Teams (IWST), Joint C2W Center (JC2WC) Teams, Land IW Activity (LIWA) and Naval IW Activity (NIWA)/Fleet IW Center (FIWC). These players can assist with IW/C2W expertise for joint/combined air campaign level targeting. The A3/A2 must determine the mix of augmentation and reachback needed to augment his own IW/C2W expertise and what the role, if any, of the 9AF IW Squadron and other IW's will be, once formed. Figure 11.3 illustrates the proposed USCENTAF IW Cell.

Table 11.1. Disabling Technologies and Kill Mechanisms.

MECHANISM	EFFECT
Combustion Chemistry	Shut off/overspeed engine Contaminate fuel
Polymer chemistry agents	Damage vital components (e.g., Air filters) Polymerize fuel system Depolymerize plastics and electrical components Runway and roadway slippery/stick Damage power grid (colloidal dust)

Antimateriel biological agents	Thicken fuels Dissolve electronics, plastics, solder, and other substances
Superagents, acids, oxiders, and dissolving agents	Damage tires Disable mines Blind optical ports/sensors
Computer viruses or worms	Subvert communications, radar, satellite and computer signals control operations
Electro-magnetic pulse (EMP)	Damage communication systems Explode ammo dumps
Blinding lasers	Blind optics, dazzle operators, overload tracking and targeting sensors
Neural inhibitors	Short circuit human synoptic pathways
Calmative agents	Tranquilize personnel
Infrasound	Sound projection to disorient, sicken, or frighten people from designated areas
Holographs	PSYOPS to convince adversaries to act in desired manner

Figure 11.3. USCENTAF IW Cell.



11.4.5. Execution Planning. The existing ATO process used to provide mission targeting data is tied to a 24- hour cycle of air combat operations. Incorporating IW techniques into an Integrated Tasking Order (ITO) may require significant evolution of the process. Potential IW weapon systems may be able to attack numerous targets within compressed time frames. In addition, generating additional information attacks from a particular weapon will not be tied to sortie turn rates and aircraft maintenance capacities. An ITO process must be developed which will be able to fully exploit IW capabilities as they become available. As IW capabilities are developed, the acquisition/ engineering team should work with targeting personnel to ensure timelines for attack planning, generation, and re-generation are known. These timelines should be taken into account and drive modifications to the existing ATO process as necessary.

11.4.5.1. Execution planning for IW will require target materials tailored to application of unique weapons systems. Existing BTGs and other materials will not suffice for direct information attack techniques. Tools which aid selection of IW DMPI equivalents will be different from the standard imagery and chart based target folders used today, and the requirement for a new line of IW target materials needs to be considered. The particular requirements for mission planning and execution will need to be taken into account in order to develop a product formatted to suit the needs of the customer. One method of providing the vast amounts of data necessary for executing IW attacks could be through "virtual" target folders. The particular information needed could be accessed through an on-line or electronic product without deluging the operational planner with a huge hard copy inventory.

11.4.6. Combat Assessment . The value of any targeting strategy is lost without an effective assessment process. The AF must explore development of ways to measure non lethal battle damage to allow for proper BDA. Planners must be able to provide probable effects of any given action to maximize the effectiveness of the IW strategy being developed, linking anticipated effects to desired objectives. Using these probable effects, planners can then identify potential indicators that something has occurred as a result of our actions and develop an IW assessment plan to task collection assets. Finally, analysts would conduct an IW reattack recommendation to evaluate the results of IW actions taken. Current imagery based BDA methodology will not suffice for IW - there may be no "smoking holes." The academic community should be tapped for technical research in this arena. The Defense Intelligence Agency is responsible in DoDD S-3600.1 "to provide the Chairman of the Joint Chiefs of Staff and the Combatant Commands with the timely intelligence required for effective IW post-strike analysis."

Chapter 12

TARGET MATERIALS

12.1. Overview. Target materials are "graphic, textual, tabular, digital, video or other physical and quantitative presentations" of target intelligence. These products locate, identify, and describe potential targets with enough accuracy to support operations against designated targets by one or more weapon systems. Target materials are also suitable for training, planning, and evaluating such operations. Three will be discussed here: Air Target Materials (ATM), Tactical Target Materials (TTM), and targeting tools.

12.2. Air Target Materials (ATM) Program (ATMP). The ATMP includes products in the form of target graphics and supporting documents required for visual and radar bombing training and operations, at both high and low altitudes. The National Imagery and Mapping Agency (NIMA) manages the ATMP. All active foreign and domestic ATM products held in inventory can be found in the NIMA Catalog, Part 4, "Target Material Products." Current ATM products include:

12.2.1. Air Target Charts (ATC). These are the standard medium scale (1:200,000) air target charts produced for areas of Korea, the Former Soviet Union, PRC, Europe, Turkey, and Southeast Asia, as well as for selected training areas in the US. Series 200 ATCs are geographically integrated charts having a sheet pattern delimited by a five-by-five (25 sheets) subdivision of the areas identified within the World Aeronautical Chart (WAC). These charts provide the cartographic, intelligence, and radar return information needed to plan, train, brief, and execute either visual or radar bombing operations at any altitude. The reverse of each sheet includes textual data describing installations depicted in the area. The graphic or textual representations on the chart include the Radar Significant Analysis Code (RSAC), Radar Significant Power Lines (RSPL), Precise Radar Significant Location (PRSL) points, Radar Fix Points (RFP), special areas and geographic coordinate information. (NOTE: PRSL information is not shown on Series 200 ATCs produced after 1 October 1978.) ATCs are being phased out; phase out date is projected for the year 2000.

12.2.2. Series 1501 Joint Operations Graphic--Radar (JOG-R). This standard medium scale (1:250,000) chart is produced for target areas where contingency operations might occur, but are not covered by ATCs. They provide RSAC, RSPL, and PRSL information and are used to support combined and joint tactical operations; pre-flight and operational planning; training, pilotage, or operational functions; and intelligence work.

12.2.3. Consolidated Air Target Materials Notices/Target Materials Bulletin, Volumes I and II. Semiannual publications that provide information affecting the operational use of the Air Target Materials. Volume I contains changes and special notices in textual form. Volume II contains change notices in graphic form (correction overlays). These two volumes are classified.

12.3. Target Materials (TM) Program (TMP). TMs are graphics providing a representation of the installation including identification, location, and textual description. The program itself was established to provide DoD users from national to unit level a common basis for communication. Its objectives are to produce and maintain tactical materials so that operational forces may deploy from one theater to another without having to adjust to new targeting procedures; to minimize duplication of effort; and to economize on production resources. For additional information on allied participation, security classifications and markings, and production specifications, refer to DIAM 57-24, *U.S./Allied Target Materials.*

12.3.1. JCS/J2T has the worldwide management responsibility for policy on TM matters such as program indoctrination; the development of new or modified materials; technical and analytical procedures; changes in production specifications; and standardization. In crisis situations, J2T also functions as a central clearinghouse to assign command approved TM production priorities and requirements to provide the supported commander with appropriate TMs in a timely manner while eliminating duplication of effort.

12.3.2. TM production is provided by designated Service and Command JIC/JACs, and by selected Allied production centers. TM production responsibilities are assigned to centers already responsible to the tasking command for general intelligence production; however, special support agreements are necessary to ensure TM production for commands without a subordinate production capability.

12.3.3. TM Products.

12.3.3.1. Automated Tactical Target Graphic (ATTG). First produced in 1971, these graphics were a total installation data base recognized as a desirable method of recording target data. ATTGs have been replaced by the Basic Target Graphic, but some are still available, particularly in areas of the world with lower production priorities. The ATTG is normally a two-section document, with one page containing the annotated target photograph and the second section containing the textual description of the installation. The information is stored on a computer punch card called an aperture card. The card program was designed to provide an imagery data base to operational units, with source material for initial contingency planning and operations. It is easily stored and can be rapidly sorted and used commonly by commands throughout the world.

12.3.3.2. Basic Target Graphic (BTG). The BTG is the basic general purpose imagery-based product used to delineate and describe the elements of a target/installation to support a wide range of target related functions. It provides a photographic database divided into two sections: the graphic page, which shows the target facility; and the text page, which provides detailed information on the target. This information is all-source, derived from imagery analysis, general intelligence data, and MC&G data. The content of a BTG is determined by EEIs developed for the functional category code of the target to which the BTG belongs.

12.3.3.2.1. BTGs can consist of several graphic pages to provide more detailed visual references for TM users. An orientation graphic provides small-scale imagery to aid in orientation and relative location of the target. A target or detail graphic is used primarily for positive target identification and clearly shows all components of the target. Unannotated graphics are added to the BTG at the producer's discretion to provide a clear view of the target graphic. An overall map view depicting the target location (on a JOG or topographic map) may be included in lieu of broad area coverage. Supplemental data and graphic sheets associated with the BTG include the Enhanced Target Graphic, Seasonal Target Graphic, Hard Target Graphic, and the Positional Data Graphic.

12.3.3.3. Training Target Graphic (TTG). The TTG is produced on CONUS and European ranges for use in military training and in exercises. They are frequently unclassified and so can be used for illustrative purposes. The format mirrors that of the BTG. The 480 IG produces TTGs.

12.3.3.4. Operational Target Graphic (OTG) . An OTG is a low volume, high detail target graphic, built to help locate hard to find and complex targets. The OTG must provide six mandatory images to include 15, 5-8, 1, and <1 NM overviews, as well as individual closeups of each functional and radar/infrared overview.

12.3.3.5. Quick Response Graphic (QRG). When target graphics are required during emergency or crisis situations, it may be necessary to modify the production standards to provide a QRG. Modifications are made by the responsible combatant command commander, who authorizes production of QRGs that use only selected EEIs in the annotations and textual description, or that eliminate all EEIs except basic identification of target components. QRGs will be identified by codes that differ from those used with BTGs. See DIAM 57-24 for more information.

12.3.3.6. Future Products . To meet rigorous targeting requirements of new weapon systems, a new TM, the Joint Digital Target Material (JDTM), is currently under development. It will provide a general reference describing an individual installation or facility's location, function, significance, critical elements, and other pertinent targeting information. The JDTM concept calls for a product consisting of text, imagery and geospatial overlays in varied formats (e.g., raster, vector), allowing a user to select and manipulate only those elements required. The JDTM will be an integrated relational set of standard formatted data pulled from varied data bases, such as MIDB and NIMA's Global Geospatial Information & Services (GGI&S), packaged in a standardized manner, and validated by a target material producer. The JDTM with its geocoded layered approach provides a means to significantly improve intelligence support to the targeting and mission planning process. Current technology supports the concept and accepted standards allow for interoperability with automated theater battle management systems.

12.4. Targeting Tools. There are three basic types of targeting tools. The first provides target intelligence on installations or facilities and contains preliminary information necessary to select potential targets. The second concerns such weaponeering tools as physical vulnerability (PV), target values, weaponeering methodology, and battle damage assessment (BDA). The data contained in these tools provide targeting personnel, weaponeers, analysts, mission planners, and decision makers with a common base of information necessary to perform the targeting function. The third provides target planning information for unit mission planning including appropriate OPlan/Conplans and directives dealing with policy and procedures. The most important targeting tools are described below:

12.4.1. Modernized Integrated Database (MIDB) . The MIDB is the key to the DoD targeting program. It is a standardized intelligence data system designed to provide for data exchange between intelligence and operational consumers from the national to tactical levels. The database contains a baseline source of intelligence on installations, military forces, population concentrations, C2 structures, significant events, and equipment. A targeting extension to the MIDB is being developed which will extract selected data fields from the database to support targeting. Of note, because of production costs, data on areas of less interest to the US intelligence community can be limited.

12.4.2. Basic Encyclopedia (BE) . This compendium of installation intelligence taken from the MIDB is the most inclusive of all installation lists. It describes every identified installation with an active function or of valid interest to intelligence agencies, particularly to the operational and planning staffs of the Unified commands. The BE contains basic data on the identification, location, and function of each installation. It may be used to select potential fixed targets for employment of ground, sea, or air weapons, or to identify installations (such as public utilities and hospitals) to be withheld from attack. The BE lists installations in five geographic areas: Eurasia; Western Europe; Latin America and the Atlantic; Middle East and Africa, and Southeast Asia and the Western Pacific.

12.4.3. Geographic Installation Intelligence Production Specifications (GIIPS). Established by DIA to provide comprehensive documentation of all product specifications for various MIDB programs. GIIPS has replaced the Target Data Inventory (TDI) handbook and Contingency Planning Facilities List (CPFL) production documentation. This handbook contains specific guidance and procedures for use in analysis, production, and processing of target intelligence by DIA, the combatant commands, Services, and other organizations responsible for maintaining the DoD installation intelligence data base.

12.4.4. Target Intelligence Handbook (TIHB) . This handbook contains specific guidance and procedures for use in analysis, production, and processing of target intelligence by DIA, the Unified and Specified commands, Services, and other organizations responsible for maintaining the DoD installation intelligence database. The TIHB includes information on BE numbering and naming procedures, security classification guidance, coordinates, abbreviations, target intelligence programs, products, and geographic areas of coverage. It is published as required to facilitate the production, maintenance, and use of the BE, GIIPS, and related target intelligence documentation programs.

12.4.5. Standard Coding System Functional Classification Handbook . This handbook contains guidance and procedures on the use of functional category codes, which classify installations by function through the use of standard intelligence codes that indicate the products, capability, or activity associated with the installation. The classification system consists of a five-digit numeric character code. The handbook is published as required and is intended for use with the BE, GIIPS, and related targeting documents.

12.4.6. Point Reference Guide Book (PRGB) . This document provides guidance for selecting reference points needed to derive geographic coordinates. Such reference points locate critical functional elements of installations in the various target categories. Each photograph or sketch depicts a sample installation, annotates the reference point at the recommended location, and explains briefly how to locate the reference point.

12.4.7. Physical Vulnerability (PV) Handbook--Nuclear Weapons . This handbook is the recognized DoD reference on the use of nuclear weapons. It is intended for use by operational planners, targeting personnel, and physical vulnerability analysts who are concerned with the delivery of nuclear weapons and the prediction of their effects.

12.4.8. Definition of Nuclear Damage . This document contains nuclear damage definitions, damage criteria, and recuperation time estimates for each major TDI category or subcategory.

12.4.9. Physical Vulnerability (PV) Data Sheets . This document provides complete physical vulnerability information for installations contained in the GIIPS whose vulnerability cannot be accurately coded using the existing vulnerability number (VN) system. The vulnerability information is presented as adjusted vulnerability numbers for use with specific yields of nuclear weapons and in the form of mathematical equations which can be readily adapted to computer use.

12.4.10. Target Value System (TVS) Manual . This manual describes the target value system used by STRATCOM/J5 to determine the relative importance of enemy installations.

12.4.11. Joint Munitions Effectiveness Manuals (JMEM) and Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) Publications. These publications deal with US systems and munitions and are the recognized DoD references on nonnuclear weapons and their effectiveness, selection, and requirements. They provide the basic data required for conventional weaponeering, including step-by-step instructions on the computations necessary. The large sections on target vulnerability and delivery accuracy are the most widely used.

12.4.12. BDA Assessment Handbooks . These handbooks are the recognized DoD references on the assessment of battle damage, either by nuclear or conventional weapons.

12.4.13. Operations Plans Appendices . Plans which task units to support specific operations normally contain an installation target list. This list allows a unit to obtain the target materials needed for mission planning and aircrew study of specific targets.

12.4.14. Operational Support Plan Graphics . These are DIA produced documents that provide detailed information on CINC tasked OPLAN targets. Data is obtained through Special Access Required programs.

12.4.15. Air Force Guide No. 2, *USAF Standard Aircraft Missile Characteristics*. Volume I, or the Green Book, and Volume II, or the Brown Book, give the characteristics and performance of aerospace systems, propulsion systems, and training equipment. Data on the systems are published initially during the validation phase and updated periodically throughout the life cycle of the system.

12.4.16. Numerical Index and Requirement Table for Fighter Aircraft Technical Orders, General Aircraft Technical Orders, and Bomber Aircraft Technical Orders. These publications provide specific technical information for detailed comparison of systems.

12.4.17. Flight Information Publications (FLIP). A series of publications presenting textual and graphic data required to plan and conduct IFR flight. The three basic categories of FLIPs are planning, enroute, and terminal.

12.4.18. Nonnuclear Consumables Annual Analysis (NCAA). This document serves as the basis for air munitions War Reserve Material planning and programming for five fiscal years.

12.5. Target Materials Users Group/Target Materials Producers Group (TMUG/TMPG) Conferences. JCS/J2T convenes semiannual TMUG/TMPG conferences to examine recommendations for improving the target intelligence and target materials program and to review associated procedures. Conferees discuss and evaluate recommendations for changes in the scope, format, content, production procedures, and specifications for a number of programs and associated documentation, such as the BE, the BTG, and several DIA manuals, handbooks, lists, and programs. The 497 IG/INOT, Targeting Division, is the Air Force voting representative to this forum.

Chapter 13

THE TARGET LOCATION

13.1. Target Location. The target location is defined by coordinates. Coordinates are "linear or angular quantities which designate the position that a point occupies in a given reference frame or system." With advancements in systems, the traditional role (previously used only as a "cueing" device to get weapon systems into the proper area) of the coordinate has changed. As a major component of weapon system circular error probable (CEP), targets that are not precisely and accurately located mean higher warhead and sortie costs. While cartographic techniques of deriving coordinates are suitable for supporting the "cueing" function, they cannot provide the precise coordinates needed for many of the newer weapon systems. Consequently, a precise geopositioning capability (PGC) was identified and developed to meet geopositioning requirements.

13.1.1. Coordinate Reference System . Coordinate reference systems are a shorthand means of communicating location on the earth's surface. The most familiar coordinate reference system uses latitude, longitude, and elevation. Others include the Universal Transverse Mercator (UTM) and Universal Polar Stereographic (UPS) grid system, which are two-dimensional. Simply put, these are grids placed on maps which allow a location to be identified without the lengthy description of degrees, minutes, and seconds of latitude and longitude. The Military Grid Reference System (MGRS) is an alphanumeric shorthand for expressing UTM and UPS coordinates with fewer numbers. Of note, a coordinate reference system always connects to a datum that defines its reference frame and point of origin; when the datum changes, so do the coordinates of the position.

13.1.1.1. Geodetic coordinates (geodetic latitude, geodetic longitude, and geodetic height) define the position of a point on the surface of the Earth with respect to the reference spheroid. Geographic coordinates, on the other hand, are quantities of latitude and longitude which only define the position of a point on a reference surface .

13.2. Datums. A critical consideration often overlooked in using coordinates is the geodetic datum upon which the coordinates and stated accuracy are based. A datum is a regional or global coordinate reference system. It includes a reference ellipsoid (a mathematical representation of the size and shape of the earth) and a specific origin point. Coordinates within the same geodetic datum are directly related to the same origin point. Coordinates within different datums must be converted to a common reference before they can be used for targeting.

13.2.1. The World Geodetic System (WGS) provides the basic reference frame and geometric figure for the earth, models the earth gravimetrically, and provides the means for relating positions on various local geodetic systems to an earth-centered, earth-fixed (ECEF) coordinate system. WGS 84 currently is the ECEF system officially authorized for DoD use. {WGS is the preferred designation, rather than WGS 84, which many assume is the currency date.} WGS represents NIMA's modeling of the earth from a geometric, geodetic, and gravitational standpoint. It was developed using new and more extensive data sets and improved computer software. The availability of a more extensive file of Doppler-derived station coordinates, improved sets of ground-based Doppler and laser satellite tracking data and surface gravity for local geodetic systems, and satellite radar altimetry for geoid heights resulted in significant improvements over the previous system (WGS 72). WGS parameters and models are constantly being upgraded as new information is being incorporated. NIMA currently does not plan to create another WGS-XX.

13.3. Measures of Accuracy. The accuracy measures provided with geospatial paper product and digital data define the envelope of reliable use. Geospatial data cannot be more accurate than its original source, and sources vary in accuracy. In addition, each step in the production process can introduce errors due to limitations of the production hardware and software, human factors, and the inherent characteristics of the product itself (i.e., size and scale of the chart or the specification accuracy for digital data). These typically manifest themselves as errors in position or elevation.

13.3.1. Classes of Errors. The production and presentation of geospatial information involves many steps. Numerous observations, measurements, and display operations are involved. Because of instrumental imperfections and human limitations, errors can occur at almost any point in the production process. These errors fall into three general classes: blunders, systematic errors, and random errors.

13.3.1.1. The basic definition of an error distribution assumes that systematic errors and blunders have been removed and only random errors are left. However, systematic errors cannot be removed from positional information unless some means exist for their detection, such as comparing this information against given control. Consequently, if systematic errors are not removed, they will have an effect, for example, on geodetic and photogrammetric measurements and the resulting positional information.

13.3.1.2. Statistical techniques are used to measure and identify these errors. These measures convey a confidence level to the user for the probably accuracy of NIMA data. Depending on the data's intended use, geospatial accuracy's are usually expressed in terms of absolute or relative accuracy, or both. *Absolute accuracy* tells how close each feature or data point is to the specified higher standard. It includes all random and systematic errors. *Relative accuracy* tells how close the measured distance or elevation is between two features or data points over a specified distance within the standard. It includes only random errors. Geospatial position accuracy is traditionally measured in feet or meters of Linear Error (LE) for heights and feet or meters of Circular Error (CE) for horizontal position, both at 90% probability. Spherical Error (SE) is the three-dimensional combination of horizontal and vertical errors at 90% probability and will be increasingly used as the measure of geospatial fidelity in the near future.

13.3.1.3. Certain weapons use circular measures of absolute and relative accuracy at 50% probability that reflect the intended uses of these systems. The 50% Circular Error Probable (CEP) figure is the radius of a circle around the target within which 50% of the weapons should fall. The remaining 50% fall outside the CEP. The Spherical Error Probable (SEP) is a three-dimensional combination of horizontal and vertical errors at 50% probability.

13.3.1.4. Target Location Error (TLE) is the difference between the actual location of the target and the expected location. Understanding and predicting TLE is particularly crucial to autonomous weapons development because of low CEP objectives. The total overall error is a statistical combination of TLE and the errors associated with the weapon (e.g., INS, GPS, aircraft, and operator).

13.3.2. Precision and Accuracy. Although the terms precision and accuracy are often used interchangeably, there is an important difference between them. "Precision" is the closeness with which repeated measurements made under similar conditions are grouped together, and "accuracy" is the closeness of the best estimated value obtained by the measurements to the "true" value of the quantity measured.

13.3.2.1. Precision is affected only by the random errors in the measuring process, while accuracy is affected by precision as well as the existence of unknown or systematic errors. Measurements may be both precise and inaccurate, but they cannot be accurate unless they are precise.

13.3.2.2. Coordinates that are developed, transmitted and used should have a format (capability) to support measurements to a deci-foot (equivalent to DDD MM SS.SSS or thousandths of an arc second). The associated accuracy of the coordinates should also be stated. The User can determine from these parameters whether the coordinate data will meet User requirements. {Note: This does not mean all coordinates must be derived to that level of precision or that the position be accurate to that level. Example: Measurements of an object on the source may be precise to the 6 inches. The positional accuracy of the object itself may within 100 feet. If the intended use is to measure the object, this precision may support the process. If the intended use is to verify the object and to bomb the object, the precision is superfluous and the accuracy may or may not be adequate based on the bombing scenario.

13.3.3. Error Budget Concept . When the strike system is not terminally guided, or when the crew member does not acquire the target visually, the aimpoint coordinate is a critical component of system accuracy. Total system accuracy may be viewed as an "error budget" in considering each source contributing to the total error. Conceptually, the CEP "error budget" is a set of systematically defined error sources, each of which contributes some identifiable portion to total system inaccuracy. The "error budget" concept allows us to systematically address error contribution to ensure that no single component is excessive. Targeting personnel must ensure that lack of target location accuracy does not degrade the overall system accuracy.

13.3.4. Precise Geopositioning Capability. Coordinate derivation is the process of generating geodetic coordinates that precisely identifies the position of a point or target. Due to the development of systems with greater precision, it is critical that the accuracy of the target coordinate be commensurate with the strike system CEP. Furthermore, the target coordinate must be described in terms common to the strike. Accurate coordinates and their conversion to a frame of reference usable by the strike system are required because it affects the system and its means of employment (tactics). Targeteers are responsible for converting target coordinates into these common terms and generating the required offset data (i.e., OAP to target, range, and bearing, or rectangular coordinates). Accuracy in describing target position, a desired ground zero (DGZ), or desired point of impact within a common reference system is a key element in targeting and is an important strike/attack cycle mission function.

13.3.4.1. Point Positioning Data Base (PPDB). PPDBs are sets of geodetically controlled photographic materials, accompanying data, and computer programs which enable trained personnel to derive accurate coordinates for any identifiable ground feature within the database area. PPDB accuracy is estimated for the entire coverage. Derivation of target or point coordinates from PPDBs requires the use of the Analytical Photogrammetric Positioning System (APPS) for mensuration and geopositioning. The APPS is a manual system in which the operator selects the APPROPRIATE stereo pair, locates the target optically, and determines the geoposition of the point. NIMA began phasing out hardcopy PPDB's production in FY96. The use of APPS and PPDBs is decreasing and will culminate as other PGCs mature.

13.3.4.2. Digital Point Positioning Data Base (DPPDB). DPPDB is a classified image product consisting of high-resolution digital stereo image pairs and replaces the hardcopy PPDB. The DPPDB provides warfighters with a deployable product from which latitude, longitude, and elevation can be quickly and accurately derived on digital exploitation workstations with stereo capability. The DPPDB consists of three main components: 1) imagery support data, 2) a digital map graphic for reference, and 3) stereo imagery. The area coverage of nominal DPPDB is a rectangle measuring 60 nm on each side. This rectangle is termed a "product rectangle". At the equator, a product rectangle is a 1 degree x 1 degree geocell and is bounded by 1 degree parallels on the north and south and by 1 degree meridians on the east and west. DPPDBs can be produced that are smaller than a product rectangle and not constrained by geocell boundaries. Ground coordinates derived using the DPPDB rational function model are referenced to the WGS ellipsoid. The absolute and relative accuracy of the DPPDB is consistent with the rigorous triangulation performed by NIMA's Digital Production System (DPS). The computed absolute and relative accuracy values, which vary from product to product, are provided as part of the imagery support data. Basic DPPDB imagery viewing and point mensuration can be performed on a suitably equipped workstation using NIMA's DEW Drop software.

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Attachment 1

GLOSSARY OF REFERENCES, ABBREVIATIONS, ACRONYMS, AND TERMS

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Abbreviations and Acronyms

AAA—Anti Aircraft Artillery

ACCI—Air Combat Command Instruction

ACFT—Aircraft

ACINT—Acoustic Intelligence (non compressed fluids)

ACO—Airspace Control Order

ACOUSTINT—Acoustic Intelligence (compressed fluids)

ACTS—Air Corps Tactical School

ADRG—ARC Digitized Raster Graphics

AFDD—Air Force Doctrine Document

AFIWC—Air Force Information Warfare Center

AFM—Air Force Manual (old designation)

AFMSS—Air Force Mission Support System

AFSST—Air Force Space Support Teams

AI—Air Interdiction

AIF—Automated Installation Intelligence File

AIS—Air Intelligence Squadron

AOC—Air Operations Center

AOR—Area of Responsibility

APPS—Analytical Photogrammetric Positioning System

APS—Advanced Planning System

ASOC—Air Support Operations Center

ASTS—Air Service Tactical School

ASW—Antisubmarine Warfare

ATC—Air Target Chart

ATM—Air Target Material

ATMP—Air Target Materials Program

ATO—Air Tasking Order

ATTG—Automated Tactical Target Graphic

AWOP—Automated Weaponeering Optimization Program

AWPD—Air War Plans Division

BDA—Battle Damage Assessment

BEI—Bridge Effectiveness Index

BTG—Basic Target Graphic

C2W—Command and Control Warfare

C3CM—Command, Control, Communications Countermeasures

C3I—Command, Control, Communications, and Intelligence

C4I—Command, Control, Communications, Computers, and Intelligence

CA—Counter Air; Combat Assessment

CAS—Close Air Support

CASSUM—CAS Summary Message

CBU—Cluster Bomb Unit

CENTAF—See USCENTAF

CENTCOM—See USCENTCOM

CEP—Circular Error Probable

CI—Counterintelligence or Counterinformation

CIA—Central Intelligence Agency

CICV—Combined Intelligence Center Vietnam

CINC—Commander in Chief

COA—Committee of Operations Analysts

COM—Collection Operations Management

COMINT—Communications Intelligence

CONOP—Concept of Operations

CONPLAN—Concept Plan (operation plan in concept format)

CONUS—Continental United States

CPFL—Contingency Planning Facilities List

CR—Collection Requirement

CRC—Control and Reporting Center

CRM—Collection Requirement Management

CSAF—Chief of Staff Air Force

CSAR—Combat Search and Rescue

CSS—Central Security Service

CTAPS—Contingency Theater Automated Planning System

DC—Crater Diameter

DCA—Defensive Counter Air

DCI—Defensive counterinformation

DCS/I—Deputy Chief of Staff for Intelligence

DEP—Deflection Error Probable

DGZ—Desired Ground Zero

DIAM—Defense Intelligence Agency Manual

DMPI—Desired Mean Point of Impact

DPI—Desired Point of Impact

DPPDB—Digital Point Positioning Data Base

DPS—Digital Production System

DTED—Digital Terrain Elevation Data

ECCM—Electronic Counter Countermeasure

ECEF—Earth-Centered, Earth-Fixed

ECM—Electronic Countermeasure

EEI—Essential Elements of Information

ELINT—Electronics Intelligence

EMD—Effective Miss Distance

EMP—Electromagnetic Pulse

EOB—Electronic Order of Battle

EW—Early Warning

FAC—Facility

FACP—Forward Air Control Party

FC—Fire Control

FEAF—Far East Air Force

FEBA—Forward Edge of Battle Area

FEC—Far East Command

FIS—Foreign Instrumentation Signals

FIWC—Fleet Information Warfare Center

FLIP—Flight Information Publication

FLOT—Forward Line of Own Troops

FSCL—Fire Support Coordination Line

GCI—Ground Control Intercept

GGI&S—Global Geospatial Information and Services

GIIPS—Geographic Installation Intelligence Production Specifications

GPS—Global Positioning System

HUMINT—Human Intelligence

IDB—Integrated Data Base

IFR—Instrument Flight Rules

IMINT—Imagery Intelligence

INS—Inertial Navigation System

INSCOM—United States Army Intelligence and Security Command

INTELINK—Intelligence Link (INTERNET for Intelligence)

IO—Information Operations

IP—Initial Point

IPA—Image Product Archive

ITO—Integrated Tasking Order

IW—Information Warfare

IWST—Information Warfare Support Teams

JAADC—Joint Area Air Defense Commander

JAC—Joint Analysis Center

JAG—Judge Advocate General

JC2WC—Joint Command and Control Warfare Center

JCS—Joint Chiefs of Staff

JDAM—Joint Direct Attack Munition

JDTM—Joint Digital Target Material

JFACC—Joint Force Air Component Commander

JFC—Joint Force Commander

JFSOCC—Joint Force Special Operations Component Commander

JIC—Joint Intelligence Center

JMEM—Joint Munitions Effectiveness Manual

JOPS—Joint Operational Planning System

JSTARS—Joint Surveillance and Target Attack Radar System

JTCG—Joint Target Coordination Board

JTF—Joint Task Force

LASINT—Laser Intelligence

LE—Linear Error

LIWA—Land Information Warfare Activity

LOAC—Law of Armed Conflict

MA—Mission Assessment

MACV—Military Assistance Command Vietnam

MAE—Mean Area Of Effectiveness

MASINT—Measurement and Signature Intelligence

MC&G—Mapping, Charting, and Geodesy

MEA—Munitions Effectiveness Assessment

MGRS—Military Grid Reference System

MIDB—Modernized Integrated Data Base

MISREP—Mission Report

MK—"Mark" item identification

MPI—Mean Points of Impact

MPS—Mission Planning Section

MRC—Major Regional Conflict

NCA—National Command Authority

NCAA—Nonnuclear Consumables Annual Analysis

NH—Number of Hits

NIMA—National Imagery and Mapping Agency

NITFS—National Imagery Transmission Format Standard

NIWA—Naval Information Warfare Activity

NM—Nautical Mile

NSA—National Security Agency

NSG—Naval Security Group

NTB—National Target Base

NUCINT—Nuclear Intelligence

OAP—Offset Aim Point

OCI—Offensive Counterinformation

OPLAN—Operations Plan

OPTINT—Optical Intelligence

OTG—Operational Target Graphic

PD—Probability of Damage

PGC—Precise Geopositioning Capability

PGM—Precision-Guided Munition

POC—Point of Contact

POL—Petroleum, Oil, and Lubricants

PPDB—Point Positioning Data Base

PRC—Peoples Republic of China

PRGB—Point Reference Guide Book

PRSL—Precise Radar Significant Location

PSB—Post Strike Base

PSYOP—Psychological Operations

QRG—Quick Response Graphic

RAAP—Rapid Application of Airpower

RADINT—Radar Intelligence

REP—Range Error Probable

RFI—Request for Information

RFP—Request for Procurement/Proposal

RINT—Unintentional Radiation Intelligence

ROE—Rules of Engagement

RSAC—Radar Significant Analysis Code

RSPL—Radar Significant Power Line

SAM—Surface-to-Air Missile

SAR—Search and Rescue

SATCOM—Satellite Communications

SCADA—Supervisory Control and Data Acquisition

SEAD—Suppression of Enemy Air Defense

SECAF—Secretary of the Air Force

SEP—Spherical Error Probable

SIGINT—Signals Intelligence

SIOP—Single Integrated Operational Plan

SIPRNET—SECRET Internet Protocol Router Network

SLAR—Sidelooking Airborne Radar

SSM—Surface-to-Surface Missile

SSPD—Single Shot Probability of Damage

STRATCOM—Strategic Command

TACC—Tactical Air Control Center

TACS—Theater Air Control System

TARBUL—Target Bulletin

TDI—Target Data Inventory

TELINT—Telemetry Intelligence

TERCOM—Terrain Contour Matching

TI—Target Intelligence

TIHB—Target Intelligence Handbook

TLAM—Tomahawk Land Attack Missile

TLE—Target Location Error

TM—Target Material

TMP—Target Materials Program

TMPG—Target Materials Producers Group

TMUG—Target Materials Users Group

TOT—Time on Target

TPFDL—Time-Phased Force and Deployment List

TTG—Training Target Graphic

TTM—Tactical Target Material

TTMC—Tactical Target Materials Catalog

TTMP—Tactical Target Materials Program

TVS—Target Value System

UAV—Unmanned Aerial Vehicle

UGS—Unattended Ground Sensors

USCENTAF—United States Central Command Air Forces

USCENTCOM—United States Central Command

USSBS—United States Strategic Bombing Surveys

UTM—Universal Transverse Mercator (map projection)

UW—Unconventional Warfare

VA—Vulnerable Area

VFR—Visual Flight Rules

VN—Vulnerability Number

WAC—World Aeronautical Chart

WGS—World Geodetic System

WPN—Weapon

Terms

ACQUIRED CHARACTERISTICS—The changes to the original or designed characteristics of an object or area.

ACTUAL GROUND ZERO—The point on the surface of the earth at, or vertically below or above, the center of actual nuclear detonation. (DoD, NATO, CENTO, IADB)

ACTUAL RANGE—In bombing, the horizontal distance a bomb travels from the instant of release until the time of impact.

AFTERWINDS—Wind currents set up in the vicinity of a nuclear explosion directed toward the burst center, resulting from the updraft accompanying the rise of the fireball. (DoD)

AIR ATTACK—:

a. Coordinated -- A combination of two or more types of air attack (dive, glide, low-level) in one strike, using one or more types of aircraft.
b. Deferred--A procedure in which attack groups rendezvous as a single unit. It is used when attack groups are launched from more than one station with their departure on the mission being delayed pending further orders.
c. Divided--A method of delivering a coordinated air attack which consists of holding the units in close tactical concentration up to a point, then splitting them to attack an objective from different directions. (DoD, IADB)

AIRBURST—:

a. An explosion of a bomb or projectile above the surface, as distinguished from an explosion on contact with the surface or after penetration.
b. (Nuclear) The explosion of a nuclear weapon in the air, at a height greater than the maximum radius of the fireball. (DoD, NATO, CENTO, IADB)

AIRSPEED—The speed of an aircraft relative to its surrounding air mass. (DoD, IADB)

AIR TARGET CHART—Standard medium scale (1:200,000) charts produced for areas of Korea, the Former Soviet Union, PRC, Europe, Turkey, and Southeast Asia, as well as for selected training areas in the US. These charts provide the cartographic, intelligence, and radar return information needed to plan, train, brief, and execute either visual or radar bombing operations at any altitude. The reverse of each sheet includes textual data describing installations depicted in the area. (DoD)

AIR TARGET MATERIALS PROGRAM (ATMP)—The ATMP includes products in the form of target graphics and supporting documents required for visual and radar bombing training and operations at both high and low altitudes. (DoD)

AIR TARGET MOSAIC—A large scale mosaic providing photographic coverage of an area and permitting comprehensive portrayal of pertinent target detail. These mosaics are used for intelligence study and in planning and briefing air operations. (DoD)

ALLOCATION—The designation of specific numbers and types of aircraft sorties for use during a specified time period or for carrying out an assigned task. (DoD, IADB)

APPORTIONMENT—Dividing of air resources among the various missions, that is, close air support, interdiction, and counter-air. (DoD)

AREA BOMBING—Bombing of a target which is in effect a general area rather than a small or pinpoint target. (DoD, NATO, CENTO, IADB)

AREA TARGET—A large area usually composed of multiple elements or components. (DoD, NATO, CENTO, IADB)

ARMING SYSTEM—That portion of a weapon which serves to ready (arm), safe, or re-safe (disarm) the firing system and fuzing system and which may actuate devices in the nuclear system. (DoD, IADB)

ASSESSMENT—Analysis of the security, effectiveness, and potential of an existing or planned intelligence activity. (DoD, IADB)

ASSIGNMENT—:

a. A specified number of complete nuclear rounds authorized for expenditure by a commander. An assignment may be made for a specific period of time, for a phase of an operation, or to accomplish a particular mission. (DoD)

b. Commitment of a particular weapon system or systems against a particular target. (DoD)

ASSURED DESTRUCTION—The capability to destroy an aggressor as a viable society, even after a well-planned and executed surprise attack on our forces. (DoD, NATO, CENTO, IADB)

AUTOMATED TACTICAL TARGET GRAPHIC (ATTG)—A tactical target materials item which provides aerial photographic coverage of a target and a limited area surrounding it at a scale permitting optimum identification of target detail. The ATTG also provides textual intelligence on a sheet separate from the graphic portion. ATTGs cover single targets and come in two forms: a lithographic sheet and a miniaturized version of an aperture card. The majority of ATTGs have been replaced by the Basic Target Graphic. (DoD)

BALLISTIC DEFLECTION ERROR—That distance, expressed in feet, in deflection measured from the mean point of impact that contains one quarter of the impact points where aiming error is disregarded and only random errors, such as are due to manufacturing tolerances and weapon stability characteristics, are considered. (TIN)

BALLISTIC DISPERSION—The variation of a path of a bomb or projectile which is attributed to physical tolerances in the weapon dimensions and to the stability of the weapon. The error produced by this variability is commonly stated as standard deviation in range and deflection of the error with respect to the mean point of impact.

BALLISTIC RANGE ERROR—That distance, expressed in feet, measured from the mean point of impact that contains one quarter of the impact points when aiming error is disregarded and only random errors, such as are due to manufacturing tolerances and weapon stability characteristics are considered. (TIN)

BASIC ENCYCLOPEDIA—A compendium of installation information describing every identified installation that has an active function or valid capacity and is of interest to intelligence agencies, particularly to the operational and planning staffs of the unified and specified commands. (DoD)

BLAST LINE—A horizontal radial line on the surface of the earth originating at ground zero on which measurements of blast from an explosion are taken. (DoD, IADB)

BOMBING ANGLE—The angle between the vertical and a line joining the aircraft to what would be the point of impact of a bomb released from it at that instant. (DoD, NATO)

BOMB, CONVENTIONAL—Any nonnuclear bomb designed for explosive, flame, penetration, smoke, or photoflash effect, as distinguished from a chemical or biological bomb.

BOMB DAMAGE ASSESSMENT—The determination of the effect of all air attacks on targets (for example, bombs, rockets, or strafe). (DoD, IADB)

BOMB IMPACT PLOT—A graphic representation of the target area, usually a pre-strike air photograph, on which prominent dots are plotted to mark the impact or detonation points of bombs dropped on a specific bombing attack. (DoD, IADB)

BOMBING ERRORS—:

a. 50% CIRCULAR ERROR--The radius of a circle, with a center at a desired mean point of impact, which contains half the ordnance independently aimed to hit the desired mean point of impact. (NATO, CENTO, IADB)

b. 50% DEFLECTION ERROR--Half the distance between two lines, drawn parallel to the aircraft's track and equidistant from the mean point of impact, which contains half the ordnance independently aimed to hit the desired mean point of impact. (NATO, CENTO, IADB)

NOTE: The above bombing errors should imply overall errors unless otherwise stipulated by inclusion of the word "random" or "systematic" where necessary. (NATO, CENTO, IADB)

BOMBING HEIGHT—Distance above the target at the moment of bomb release, measured vertically from the target to the level of the bombing aircraft. (NATO, CENTO, IADB)

BOMB LINE—An imaginary line arranged, if possible, to follow well-defined geographical features, prescribed by the troop commander and coordinated with the Air Force commander, forward of which Air Forces are free to attack targets without danger to or reference to ground forces. Behind the line all attacks must be coordinated with the appropriate troop commander.

BOMB RELEASE LINE—An imaginary line around a defended area or objective over which an aircraft should release its bombs in order to obtain a hit in an area or objective. (DoD, NATO, IADB)

BOMB RELEASE POINT—The point in space at which bombs must be released to reach the desired point of detonation. (DOD, NATO, CENTO, IADB)

BREAKAWAY—The onset of a condition in which the shock front moves away from the exterior of the expanding fireball produced by the explosion of a nuclear weapon. (DOD, NATO, CENTO)

BUFFER DISTANCE (NUCLEAR):—

a. The horizontal distance which when added to the radius of safety will give the desired assurance that the specified degree of risk will not be exceeded. The buffer distance is normally expressed quantitatively in multiples of delivery error.

b. The vertical distance which is added to the fallout safe height of burst in order to determine a desired height of burst which will provide the desired assurance that militarily significant fallout will not occur. It is normally expressed in multiples of the vertical error. (DOD, NATO, CENTO, IADB)

C2 ATTACK—Any action against any element of the enemy's command and control system.

CARPET BOMBING—The progressive distribution of a mass bomb load upon an area defined by designated boundaries, in such a manner as to inflict damage to all portions thereof. (DOD, NATO, CENTO, IADB)

CIRCULAR ERROR—An error associated with delivery of munitions on a target. It is the distance measured between the desired and actual points of impact of a munition. (DOD, NATO, CENTO, IADB)

CIRCULAR ERROR PROBABLE—:

a. An indicator of the delivery accuracy of a weapon system, used as a factor in determining probable damage to a target. It is the radius of a circle within which half of the missiles or projectiles are expected to fall.

b. An indicator of the accuracy of a missile or projectile, used as a factor in determining probable damage to a target. It is the radius of a circle within which half of the missiles or projectiles are expected to fall.

c. A measure of aiming accuracy expressed in feet. Its value is estimated by the radius of a circle, with its center at the mean point of impact containing half of the impact points of independently aimed bombs or half of the mean points of impact (MPI) resulting from independent aiming operations. The circular error probable is associated with the circular normal distribution with an aiming error standard deviation equal to 0.849 CEP and is a meaningful measure of accuracy if the impact pattern is reasonably circular. As the pattern becomes more elliptical, Deflection Error Probable (DEP) and Range Error Probable (REP) become more accurate descriptions of the pattern (DOD, IADB)

CLEAN WEAPON—A nuclear weapon in which measures have been taken to reduce the amount of residual radioactivity relative to a "normal" weapon of the same energy yield. (NATO, CENTO, IADB)

COLLATERAL DAMAGE—The damage to surrounding resources, either military or non-military, as the result of actions or strikes directed specifically against enemy forces or military facilities. (DOD, NATO, CENTO, IADB)

COMMAND and CONTROL—The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of the mission.

COMPLETE ROUND—A term applied to an assemblage of explosive and non-explosive components designed to perform a specific function at the time and under the conditions desired. Examples of complete rounds are:

a. Separate loading--consisting of a primer, propelling charge, and except for blank ammunition, a projectile and fuze;

b. Fixed or semifixed--consisting of a primer, propelling charge, cartridge case, a projectile, and a fuze except when solid projectiles are used;

c. Bomb--consisting of all component parts required to drop and function the bomb once;

d. Missile--consisting of a complete warhead section and a missile body with its associated components and propellants; and

e. Rocket--consisting of all components necessary, for it to function.

CONTACT BURST PRECLUSION—a fuzing arrangement which prevents an unwanted surface burst in the event of failure of the airburst fuze. (DOD)

CONTAMINATION—The deposit and/or absorption of radioactive material, biological, or chemical agents on and by structures, areas, personnel, or objects. (DOD, NATO, CENTO, IADB)

CONTINGENCY PLANNING FACILITIES LIST (CPFL)—A joint Defense Intelligence Agency/unified and specified command program for the production and maintenance of current target documentation of all countries of contingency planning interest to United States military planners. (DOD)

CONTINUOUSLY COMPUTED RELEASE POINT—Solution of the weapon delivery release point by continuous prediction of the release point for a given set of ballistics, altitudes, and airspeeds. (NATO)

CONTROLLED EFFECTS NUCLEAR WEAPONS—Nuclear weapons designed to achieve variation in the intensity of specific effects other than normal blast effect. (DOD)

COUNTERFORCE—The employment of strategic air and missile forces in an effort to destroy or render impotent, selected military capabilities of an enemy force under any of the circumstances by which hostilities may be initiated. (DOD, IADB)

COUNTERINFORMATION—Actions designed to establish a desired degree of information superiority to enable friendly use of the information environment while impeding the use of the same environment by the adversary. Includes offensive and defensive counterinformation.

COUNTERVALUE—The employment of strategic air and missile forces against an enemy's urban industrial economic base in an attempt to destroy his ability or will to support the war-making effort. (DOD, NATO, CENTO, IADB)

DAMAGE CRITERIA—The critical levels of various effects such as blast procedure and thermal radiation required to achieve specified levels of damage. (DOD, IADB)

DAMAGE MECHANISMS—Characteristics of the effects of the warhead or munition that is delivered (for example, fragmentation, incendiary, etc.).

DEFENSIVE COUNTERINFORMATION—Actions protecting our military information functions. It includes security measures (information assurance and operations security), counterintelligence, counterdeception, and counterpsychological operations.

DEFLECTION ERROR—An error associated with delivery of munitions on a target. It is the distance measured between an imaginary line drawn through the desired point of impact and an imaginary line drawn through the actual point of impact, both lines drawn parallel to the axis of attack. (DOD, NATO, CENTO, IADB)

DEFLECTION ERROR PROBABLE—:

a. A value equal to half the distance between two imaginary lines which are drawn parallel to the aircraft's track, are equidistant from the desired point of impact, and contain half the impact points of independently aimed weapons. (DOD, NATO, CENTO, IADB)

b. A measure of aiming accuracy expressed in feet. Its value is estimated by half the distance between two lines, drawn parallel to the aircraft's track, that are equidistant from the desired mean point of impact and contain half the impact points resulting from independent aiming operations. If the impact pattern is bivariant normal as is usual, the aiming error standard deviation is equal to 1.483 DEP. (DOD, NATO, CENTO, IADB)

DEFLECTION SINGLE SHOT PROBABILITY OF DAMAGE—The probability of achieving a specified damage criterion against a target assuming no range error and a weapon reliability of 100 percent. (TIN)

DEGREE OF RISK (NUCLEAR)—As specified by the commander, the risk to which friendly forces may be subjected from the effects of the detonation of a nuclear weapon used in the attack of a close-in enemy target; acceptable degrees of risk under differing tactical conditions are emergency, moderate, and acceptable. (DOD, IADB)

DESIRED GROUND ZERO—The point on the surface of the earth at, or vertically above or below, the center of a planned nuclear detonation. (DOD, NATO, CENTO, IADB)

DESIRED MEAN POINT OF IMPACT—The planned point whose coordinates are the arithmetic means of the coordinates of the separate points of impact of a finite number of projectiles fired or released at the same aiming point under a given set of conditions.

DEVIATION:—

a. The distance by which a point of impact or burst misses the target.

b. The angular difference between magnetic and compass headings. (DOD, NATO, CENTO, IADB)

DIRECT INFORMATION WARFARE—Changing the adversary's information without involving the intervening perceptive and analytical functions.

DIRTY WEAPON—A weapon which produces a larger amount of residual radioactivity than a "normal" weapon of the same energy yield.

DISPERSION ERROR—The distance from the point of impact or burst of a round to the mean point of impact or burst. (DOD, NATO, CENTO, IADB)

DIVE TOSS—A weapon delivery maneuver in which the aircraft is dived to a predetermined altitude and point in space, pulled up, and the weapon released in such a way that it is tossed into the target.

DYNAMIC PRESSURE—Pressure resulting from some medium in motion, such as the air following a shock front of a blast wave. (DOD, NATO, CENTO)

EFFECTIVE MISS DISTANCE—The distance which munitions may miss the desired point of impact or detonation and still cause the desired damage to the target. (DOD, NATO, CENTO, IADB)

EFFECTIVE PATTERN LENGTH—An expression of the length of the stick plus twice the radius of the cluster for stick-delivered cluster munitions. (TIN)

EFFECTIVE PATTERN WIDTH—An expression of the width of the stick plus the radius of the cluster for stick-delivered cluster munitions. (TIN)

EFFECTIVE TARGET AREA LENGTH—An expression of the length of the target area plus twice the range weapon radius for stick-delivered munitions. (TIN)

EFFECTIVE TARGET AREA WIDTH—An expression of the target area width plus twice the weapon radius in deflection. (TIN)

EFFECTIVE TARGET DIAMETER—An expression of the target diameter plus twice the miss distance within which a miss will produce the desired damage. (TIN)

EFFECTIVE TARGET LENGTH—An expression of the length of the target plus the miss distance within which the weapon will produce the desired damage (or for bridges, the diagonal distance across the bridge along the approach axis). (TIN)

EFFECTIVE TARGET VULNERABLE LENGTH—An expression of the effective target length multiplied by the probability that a hit produces the desired damage. (TIN)

EFFECTIVE TARGET WIDTH—An expression of the width of the target plus the miss distance within which the weapon will produce the desired damage (or for bridges, the width of the bridge perpendicular to the aircraft's approach axis). (TIN)

ELECTROMAGNETIC RADIATION PROPAGATION—The emission or transmission of wave energy; gamma radiation; x-rays; visible, infrared, and ultraviolet radiation; and radar and radio transmissions. (DoD, IADB)

EMERGENCY RISK (NUCLEAR)—A degree of risk where anticipated effects may cause some temporary shock, casualties, and may significantly reduce the unit's combat efficiency. (DoD, NATO, CENTO, IADB)

ENVIRONMENTAL SCALE FACTOR—A factor to account for the weapon effectiveness degradation due to jungle foliage, tall grass, etc. (TIN)

EXECUTING COMMANDER (NUCLEAR WEAPONS)—A commander to whom nuclear weapons are released for delivery against specific targets or in accordance with approved plans. (DoD, NATO, CENTO, IADB)

EXO-ATMOSPHERIC BURST (NUCLEAR)—The explosion of a nuclear weapon (above 120 kilometers) where atmospheric interaction is minimal. (DoD, IADB)

FALLOUT—The precipitation to earth of radioactive particulate matter from a nuclear cloud; also applied to the particulate matter itself. (DoD, NATO, CENTO, IADB)

FALLOUT PREDICTION—An estimate, made before and immediately after a nuclear detonation, of the location and intensity of military significant quantities of radioactive (DoD, IADB)

FALLOUT SAFE HEIGHT OF BURST—The height of burst at or above which no military significant fallout will be prided as a result of a nuclear weapon detonation. (DoD, IADB)

FALLOUT WIND VECTOR PLOT:—

a. A wind vector based on the wind structure from the earth's surface to the highest altitude affecting fallout pattern.

b. A wind vector diagram based on the wind structure from the earth's surface to the highest altitude of interest. (DoD, IADB)

FIRST STRIKE—The first offensive move of a war. (Generally associated with nuclear operations.) (DoD, IADB)

FIRST STRIKE CAPABILITY—The ability of a nation to launch a first strike without receiving unacceptably high damage in return. (TIN)

FIRST USE—The initial use of nuclear weapons by either party of a conflict. This can apply to a first strike or retaliatory strike.

FLASH BURN—A burn caused by excessive exposure of bare skin to thermal radiation. (DoD, NATO, CENTO, IADB)

FLESHETTE—A small, inert, fin-stabilized missile. A large number may be loaded into a single warhead. (TIN)

FUZE—A device designed to initiate detonation in any type of ammunition by an action such as hydrostatic pressure, target proximity, chemical impact, mechanical time, or a combination of these. Various types of fuses are:

a. Air nose--a point-detonating rocket fuze which uses vanes rotated by the air stream to arm itself.

b. Air pressure--A barometric fuze.

c. All way -- An impact fuze designed to function regardless of its orientation on impact.

d. Ambient--A type of proximity fuze which is not activated as a consequence of actual determination of target presence but by a measurement of parameters associated with the environment in which the target is normally found.

e. Fuse and burster--A combination of fuze and burster for use in a bomb, such as a liquid-filled incendiary bomb, which may be filled in the field.

f. Antidisturbance--A fuze designed to become armed after the weapon is emplaced, so that any further movement or disturbance will result in detonation.

g. Antiwithdrawal--A fuze incorporating an antiwithdrawal device.

h. Barometric--A fuze that functions as a result of change in the ambient air pressure.

i. Combination--A fuze combining two different types of fuze mechanisms; especially one combining impact and time mechanisms.

j. Delay--A fuze incorporating a means of delaying its action after sensing the target. Delay fuses are classified according to the length of time they delay.

k. Electrical--A fuze which depends upon events of an electrical or electronic nature for its arming and functioning. Such a fuze may not be entirely electrical, but may contain mechanical components.

  1. Electric time--A fuze in which the time from initiation of action to functioning is controlled electrically.

m. Impact--A fuze whose action is initiated by the force of impact; also called a contact or percussion fuze.

n. Contact--A fuze where primary initiation results from actual contact with an object, including such phenomena as impact, crush, tilt, or electrical contact.

o. Inertial--A fuze using acceleration forces to establish location in trajectory. It senses rate of change in velocity due to thrust or drag forces and transforms this data to a distance measurement by an integrating device or other methods.

p. Influence--A fuze initiated by changes in the environment of the fuze; for example, magnetic thermal, or movement changes.

q. Long delay--A type of delay fuze, especially for land mines, in which the fuze action is delayed for a relatively long period of time, up to days.

r. Mechanical--Any fuze which depends for its arming and functioning on events primarily of a mechanical nature such as a clock-type mechanism.

s. Mechanical and superquick--A mechanical time fuze containing an additional device designed to cause instantaneous activation as a result of impact.

t. Medium delay -- A type of delay fuze, especially for bombs, in which the fuze action is delayed for a period of time between that of a short delay and long delay fuses. This delay is normally four to fifteen seconds.

u. Nondelay--A fuze that functions as a result of the inertia of a firing pin as the fuze is retarded during penetration of an object. The inertia causes the firing pin to strike the primer, initiating fuze action. This type of fuze is inherently slower in action than the superquick or instantaneous fuze since its action depends upon deceleration of the missile during impact with an object.

v. Nose--A fuze for use in the forward end (nose) of a bomb or other type of missile.

w. Proximity--A fuze wherein primary initiation occurs by sensing the presence, distance or direction of an object through the characteristics of the object itself or its environment. This name is preferred over synonymous terms such as VT fuze.

x. Selective delay--A delay fuze which permits a selection from two or more functioning times.

y. Self-destroying--A fuze containing a device which causes the projectile bursting charge to detonate if prior functioning has not been caused by object presence or other triggering mechanisms.

z. Superquick--A type of delay fuze used in bombs in which the fuze action is delayed for a short period of time, usually less than one second.

aa. Tail--A fuze designed to be inserted in the tail of a bomb.

ab. Time--A fuze designed to function after the lapse of a predetermined period of time.

ac. VT--See proximity fuze.

FUZE ERROR—The variation in the fuze functioning time from the intended functioning time. (TIN)

FUZE SAFE-ARMING DISTANCE—The distance from the aircraft within which an unintentional warhead burst could result in injury to flight personnel or serious damage to the aircraft. (TIN)

GLIDE BOMBING—The action of bombing a target from an aircraft at dive angles of 30 degrees or less. (DoD, IADB)

GROSS ERROR—A nuclear weapon detonation at such a distance from the desired ground zero as to cause no nuclear damage to the target. (DoD)

GROUND ZERO—The point on the surface of the earth at, or vertically below or above, the center of a planned or actual nuclear detonation. (DoD, NATO CENTO, IADB)

HEIGHT OF BURST—:

a. The vertical distance from the earth's surface oar target to the point of burst.

b. For nuclear weapons, the optimum height for a particular target (or area) is that at which it is estimated a weapon of a specified energy yield will produce a certain desired effect over the maximum possible area. (DoD, NATO, CENTO, IADB)

HEIGHT OF BURST ERROR PROBABLE—Error in height of burst which missile or projectile fuses may be expected to exceed as often as not.

HIGH ALTITUDE BURST—The explosion of a nuclear weapon which takes place at a height in excess of 100,000 feet. (NATO)

HIGH ALTITUDE BOMBING—Horizontal bombing with the height of release over 15,000 feet. (DoD, IADB)

HORIZONTAL ERROR—The error in range, deflection, or radius, which a weapon may be expected to exceed as often as not. Horizontal error of weapons making a nearly vertical approach to the target is described in terms of circular error probable. Horizontal error of weapons producing elliptical dispersion patterns is expressed in terms of probable error. (DoD NATO, CENTO, IADB)

IMMEDIATE MISSIONS—Those missions for which specific target makeup and location cannot be determined in advance.

IMMEDIATE NUCLEAR SUPPORT—Nuclear support to meet specific requests which arise during the course of a battle and which by their nature cannot be planned in advance. (DoD, IADB)

INDIRECT INFORMATION WARFARE—Changing the adversary's information by creating phenomena that the adversary must then observe and analyze.

INFORMATION—Data and instructions.

INFORMATION ATTACK—Directly corrupting information without visibly changing the physical entity within which it resides.

INFORMATION FUNCTIONS—Any activity involving the acquisition, transmission, storage, or transformation of information.

INFORMATION OPERATIONS—Actions taken to access or affect information or information systems while defending our own.

INFORMATION SUPERIORITY—The ability to collect, control, exploit, and defend information while denying an adversary the ability to do the same.

INFORMATION WARFARE—Information operations conducted primarily during the time of crisis or conflict to achieve information superiority and other military objectives.

INITIAL POINT—:

a. The first point at which a moving target is located on a plotting board.

b. A well-defined point, easily distinguishable visually or electronically, used as a starting point for the bomb run to the target. (DoD, IADB)

INITIAL RADIATION—The radiation, essentially neutrons and gamma rays, resulting from a nuclear burst and emitted from the fireball within one minute after burst. (DoD, NATO, CENTO, IADB)

INSTALLATION—A grouping of facilities located in the same vicinity, which support particular functions. (DoD, IADB)

INSTALLATION DATA BASE—A set of intelligence data about installations in a geographic region or functional grouping, usually but not necessarily filed in a computer and used as a base for a variety of intelligence products.

INSTALLATION INTELLIGENCE—The intelligence pertaining to the basic elements of information on an installation which is derived from single or multiple sources of information and used as an intelligence data base.

INSTALLATION LIST—A compendium of objects or areas used primarily for reference purposes.

JOINT MUNITIONS EFFECTIVENESS MANUALS—A DoD publication series containing data and methodologies for conventional weaponeering. (TIN)

KILL EFFECTS—Destructive effects available upon detonation of a weapon. Kill effects are blast, penetration, perforation, fragmentation, cratering, earth shock, fire, nuclear and thermal radiation, and combinations of these in varying degrees. (DoD, NATO, CENTO, IADB)

LASER GUIDED BOMB (LGB)—A general purpose bomb fitted with a special guidance and control kit which will guide the freefall towards a target illuminated by a laser beam. (DoD, NATO, CENTO, IADB)

LASER TARGET DESIGNATION—The use of a laser to direct a light beam onto the target so that appropriate sensors can track or home on the reflected energy.

LAYDOWN BOMBING—A very low level bombing technique wherein delay fuzes or devices are used to allow the attacker to escape the effects of the bomb. (DoD, NATO, CENTO, IADB)

LINEAR TARGET—A target characterized by a long and narrow shape; for example, a runway or railroad track.

LOFT BOMBING—A method of bombing in which the delivery aircraft approaches the target at a very low altitude, makes a definite pull-up at a given point, releases the bomb at a predetermined point during the pull-up, and tosses the bomb onto the target. (DoD, IADB)

LOW AIRBURST—The fallout safe height of burst for a nuclear weapon which maximizes damage to or casualties on surface targets. (DoD, IADB)

LOW ANGLE DROGUE DELIVERY (LADD)—A method of bombing that employs a timed release system based upon a ground reference point on a target. (TIN)

MACH STEM—The shock front formed by the fusion of the incident and reflected shock fronts from an explosion. The term is generally used with reference to a blast wave, propagated in the air, reflected at the surface of the earth. In the ideal case, the Mach stem is perpendicular to the reflecting surface and slightly convex. Also known as Mach front. (DoD, NATO, CENTO)

MEAN AREA OF EFFECTIVENESS (MAE)—A measurement, in square feet, of an abstract area determined by dividing the area affected by a weapon into small elements and, finally, summing the product of the probability of damage within each element and the area of each element. MAE depends upon target vulnerability, weapon characteristics, impact velocity, weapon angle of fall, and burst height. (DoD, NATO, CENTO)

MEAN POINT OF IMPACT:—

a. The point whose coordinates are the arithmetic means of the coordinates of the separate points of impact of a finite number of projectiles fired or released at the same aiming point under a given set of conditions.

b. The point that has as its range and deflection coordinates the arithmetic means of the range and deflection coordinates and the individual weapon impact points. (DoD, NATO, CENTO, IADB)

MEDIUM ALTITUDE BOMBING—Horizontal bombing with the height of release between 9,000 and 14,000 feet. (DoD, IADB)

MEGATON WEAPON—A nuclear weapon, the yield of which is measured in millions of tons of TNT explosive equivalents. (DoD, NATO, CENTO, IADB)

MILITARY INFORMATION FUNCTION—Any information function supporting and enhancing the employment of military forces.

MILITARILY SIGNIFICANT FALLOUT—Radioactive contamination capable of inflicting radiation doses to personnel which may result in a reduction of their combat effectiveness. (DoD, IADB)

MINIMUM ALTITUDE BOMBING—Horizontal or glide bombing with the height of release under 900 feet. It includes masthead bombing, which is sometimes erroneously referred to as skip bombing. (DoD, IADB)

MINIMUM SAFE DISTANCE (MSD)—(NUCLEAR)--The sum of the radius of safety and buffer distance. (DoD, NATO, CENTO, IADB)

MISSION PLANNING—Premission preparation to a crew with all necessary information and material to successfully deliver a weapon against an assigned target. (TIN)

MODERATE DAMAGE—Damage which prevents the use of equipment or installations until extensive repairs are made. (DoD, NATO, CENTO, IADB)

MODERATE RISK (NUCLEAR)—A degree of risk where anticipated effects are tolerable, or at worst, a minor nuisance. (DoD, NATO, CENTO, IADB)

MUNITION:—

a. In a broad sense, any and all supplies and equipment required to conduct offensive or defensive war, including war machines, ammunition, transport, etc.

b. In a restricted sense, ordnance.

MUNITIONS DELIVERY ERROR—An error associated with the delivery of munitions on a target which occurs after release or launch of the weapon. The error is measured in distance between the desired and actual points of impact. (DoD, NATO, CENTO, IADB)

NATIONAL STRATEGIC TARGET LIST (NSTL)—A listing of all installations of strategic targeting importance.

NATIONAL TARGET BASE—The JSTPS produced and maintained file of installations which, individually and collectively, meet the requirements for achieving the national targeting objectives specified in the JCS guidance as implemented in the SIOP or the theater nuclear employment plans of the unified and specified commands.

NEGLIGIBLE RISK (NUCLEAR)—A degree of risk where personnel are reasonably safe, with the exceptions of dazzle or temporary loss of night vision. (DoD, NATO, CENTO, IADB)

NUCLEAR COORDINATION—A broad term encompassing all the actions involved with planning nuclear strikes, including liaisons between commanders for the purpose of satisfying support requirements or because of the extension of weapons effects into the territory of another. (DoD, IADB)

NUCLEAR DAMAGE ASSESSMENTS—The determination of the damage effects to the population, forces, and resources resulting from nuclear attack. It is performed during the trans-attack and post-attack periods. It does not include the function of evaluating the operational significance of nuclear damage assessments. (DoD, NATO, CENTO, IADB)

NUCLEAR WARNING MESSAGE—A warning message which must be disseminated to all affected forces any time a nuclear weapon is to be detonated if effects of the weapon will have impact on those forces. (DoD, IADB)

NUCLEAR YIELDS—The energy released in the detonation of a nuclear weapon, measured in terms of the kilotons or megatons of TNT required to produce the same energy release. Yields are categorized as:

a. Very low--less than 1 kiloton.

b. Low--1 kiloton to 10 kilotons.

c. Medium--over 10 kilotons to 50 kilotons.

d. High--over 50 kilotons to 500 kilotons.

e. Very high -- over 500 kilotons. (NATO CENTO)

OFFENSIVE COUNTERINFORMATION—Actions taken to affect an adversary's military information functions. It includes psychological operations (PSYOP), electronic warfare, military deception, physical attack, and information attack.

OFFSET AIMING POINT (OAP)—The radar significant ground fix point used in the offset bombing mode. (TIN)

OFFSET BOMBING—Any bombing procedure which employs a reference or aiming point rather than the actual target. This type of bombing is employed when the target cannot be seen or is a poor reference point. (NATO)

ON-CALL TARGET—A planned nuclear target other than a scheduled nuclear target for which a need can be anticipated but which will be delivered on request rather than at a specific time. Coordination and warning of friendly troops are mandatory. (DoD, IADB)

OPTIMUM HEIGHT OF BURST—For nuclear weapons the height of burst for a particular target or area is that at which it is estimated a weapon of a specified energy yield will produce a certain desired effect over the maximum possible area. (DoD, NATO, IADB)

OVERPRESSURE—The pressure resulting from the blast wave of an explosion. It is referred to as "positive" when it exceeds atmospheric pressure and "negative" when less than atmospheric pressure. (DoD

NATO, CENTO, IADB)

OVER-THE-SHOULDER BOMBING—A special case of loft bombing, where the bomb is released past the vertical in order that the bomb may be thrown back to the target. This method is also known as the Low Altitude Bombing System (LABS). (DoD, IADB)

PEAK OVERPRESSURE—The maximum value of overpressure at a given location which is generally experienced at the instant the shock (or blast) wave reaches that location. (DoD, NATO, CENTO, IADB)

PEAK PRESSURE—The measure of the maximum force exerted against an object by a blast wave and equals the pressure exerted multiplied by the area over which it acts.

PERMISSIVE ACTION LINK—A device included in or attached to a nuclear weapon system to preclude arming or launching until the insertion of a prescribed discrete code or combination. (DoD)

PLANNED TARGET (NUCLEAR)—A nuclear target planned on an area or point in which a need is anticipated. A planned nuclear target may be scheduled or on call, and firing data may or may not be determined in advance. (DoD, IADB)

POINT TARGET—:

a. A target of such small dimensions that it requires the accurate placement of ordnance in order to neutralize or destroy it.

b. (NUCLEAR) A target in which the ratio of radius of damage to target radius is equal to or greater than 5. (DoD, IADB)

POTENTIAL TARGETS—An enemy entity, one that satisfies the foregoing criteria, does not become a target until military action is planned against it. That action may include capture, destruction, disruption, degradation, neutralization, or exploitation.

PRECAUTIONARY LAUNCH—The launching of nuclear loaded aircraft under imminent nuclear attack so as to preclude friendly aircraft destruction and loss of weapons on the ground or carrier. (DoD)

PRECURSOR—A pressure wave which precedes the main blast wave of a nuclear explosion. (DoD, NESN, NFSN, IADB)

PREPLANNED MISSIONS—Those missions for which a requirement can be foreseen, thereby permitting detailed planning and coordination.

PREPLANNED NUCLEAR SUPPORT—Nuclear support planned in advance of operations. (DoD, IADB)

PROBABILITY OF DAMAGE—The probability that damage will occur to a target expressed as a percentage or as a decimal. (DoD, NATO, CENTO IADB)

PROBABILITY OF PERISHABILITY—The likelihood that a target has changed significantly within the time parameters of the established targeting time budget.

PROJECTILE—An object projected by an applied exterior force and continuing in motion by virtue of its own inertia, as a bullet, shell, or grenade. Also applied to rockets and guided missiles. (DoD, NATO, CENTO, IADB)

RADIAL ERROR—An error associated with delivery of munitions on a target. It is the distance between the desired point of impact and actual point of impact, both points projected and measured on an imaginary plane drawn perpendicularly to the flight path of the munition.

RAD—Unit of absorbed dose of radiation. It represents the absorption of 100 ergs of nuclear (or ionizing) radiation per gram of the absorbing material or tissue. (DoD, NATO, CENTO, IADB)

RADIUS OF DAMAGE—The distance from ground zero at which there is a 0.50 probability of achieving the desired damage. (DoD, IADB)

RADIUS OF SAFETY—The horizontal distance from ground zero beyond which the weapon effects on friendly troops are acceptable. (DoD, NATO, CENTO, IADB)

RAINOUT—Radioactive material in the atmosphere brought down by precipitation. (DoD, NATO, CENTO, IADB)

REFLECTED SHOCK WAVE—When a shock wave traveling in a medium strikes the interface between this medium and a denser medium, part of the energy of the shock wave in the denser medium and the remainder of the energy results in the formation of a reflected shock wave which travels back through the less dense medium. (DoD, IADB)

RELEASING COMMANDER (NUCLEAR WEAPONS)—A commander who has been delegated authority to approve the use of nuclear weapons within prescribed limits. (DoD, NATO, CENTO, IADB)

REM (ROENTGEN EQUIVALENT MAMMAL)—One REM is the quantity of ionizing radiation of any type which, when absorbed by men or other mammals produces a physiological effect equivalent to that produced by the absorption of one roentgen of X-ray or gamma radiation. (DoD, IADB)

RESIDUAL RADIATION—Nuclear radiation caused by fallout, radioactive material dispersed artificially, or irradiation which results from a nuclear explosion and persists longer than one minute after burst. (NATO, CENTO)

RULES OF ENGAGEMENT—Directives issued by competent military authority which specify the circumstances and limitations under which United States forces will initiate or continue combat engagement with other forces encountered. (NATO)

SAFE BURST HEIGHT—The height of burst at or above which the level of fallout, or damage to ground installations is at a predetermined level acceptable to the military commander. (DoD, NATO, CENTO, IADB)

SALTED WEAPON—A nuclear weapon which has, in addition to its normal components, certain elements or isotopes which capture neutrons at the time of the explosion and produce radioactive products over and above the usual radioactive weapon debris. (DoD, NATO, CENTO, IADB)

SCHEDULED TARGET—A planned target on which a nuclear weapon is to be delivered at a specified time during an operation of the supported force. The time is specified in minutes before or after a designated time or in terms of the accomplishment of a predetermined movement or task. (DoD, IADB)

SECOND STRIKE—The first counterblow of a war (generally associated with nuclear operations). (DoD, IADB)

SECOND STRIKE CAPABILITY--The ability of a nation to inflict unacceptable damage on an enemy who struck first. (NATO, CENTO, IADB)

SENSOR HARVEST—SENSOR HARVEST is a command and control warfare target analysis support (CTAS) tool produced by the Air Force Information Warfare Center. This product is designed to support the joint forces air component commander (JFACC) with a C2W intelligence tool that considers operations security (OPSEC), deception, psychological operations (PSYOP), electronic warfare (EW) and physical destruction while it is being constructed. The end result is a list of recommended C2W target nominations.

SHOCK FRONT—The boundary between the pressure disturbance created by an explosion (in air, water, or earth) and the ambient atmosphere, water, or earth. (DoD, NATO, CENTO, IADB)

SHOCK WAVE—The continuously propagated pressure pulse formed by the blast from an explosion; in air by the air blast, underwater by the water blast, and underground by the earth blast. (DoD, NATO, CENTO, IADB)

SINGLE SHOT PROBABILITY OF DAMAGE—The statistical likelihood of achieving a stated damage criterion against a target with a single weapon. (TIN)

SINGLE WEAPON EFFECTIVE LENGTH—A computational factor equal to twice the sum of the deflection weapon radius and the ballistic deflection error. (TIN)

SKIP BOMBING—A method of aerial bombing in which the bomb is released from such a low altitude that it slides or glances along on the surface of the water or ground and strikes the target at or above the water or ground level. (DoD, IADB)

SPAN OF DETONATION (ATOMIC DEMOLITION MUNITION EM—PLOYMENT)--That total period of time resulting from a timer error between the earliest and latest possible detonation time. (DoD)

STICK—A succession of bombs released separately at predetermined intervals from an aircraft.

STICK PATTERN LENGTH—An expression in feet of the distance between the first and last bomb impacts in a stick or the distance between the center of the first and last impacts of the cluster patterns for the stick delivery of dispenser weapons. (TIN)

STICK WIDTH—An expression in feet of the width of the impact pattern of a stick of weapons. It includes the contributions due to the location of weapons on the aircraft and the rack ejection velocities. (TIN)

SURFACE BURST (NUCLEAR)—An explosion of a nuclear weapon at the surface of land or water; or above the surface, at a height less than the maximum radius of the fireball. (DoD, NATO. CENTO, IADB)

TACTICAL NUCLEAR WEAPON EMPLOYMENT—The use of nuclear weapons by land, sea, or air forces against opposing forces, supporting installations or facilities in support of operations which contribute to the accomplishment of a military mission of a limited scope or in support of the military commander's scheme of maneuver, usually limited to the area of military operations. (DoD, IADB)

TACTICAL TARGET MATERIALS (TTM)—Materials which provide a graphic representation of individual or multiple facilities, installations, or targets with specific identification, geographic location, and textual description of location and physical characteristics. (DoD)

TACTICAL TARGET MATERIALS PROGRAM (TTMP)—A DoD program established for the production of tactical target materials and related items in support of unified and specified command and allied participant TTM requirements. (DoD)

TARGET—:

a. A geographical area, complex, or installation planned for capture or destruction by military forces.

b. In intelligence usage, a country, area, installation, agency, or person against which intelligence operations are directed.

c. An area designated and numbered for future firing.

d. In gunfire support usage, an impact burst which hits the target.

e. A thing or place to be aimed at or hit. (DoD, NATO, IADB)

TARGET ACQUISITION—The detection identification, and location of a target in sufficient detail to permit the effective employment of weapons. (DoD, NATO, CENTO, IADB)

TARGET ANALYSIS—An examination of potential targets to determine military importance, priority of attack, and weapons required to obtain a desired level of damage or casualties. (DoD, NATO, CENTO, IADB)

TARGET ARRAY—A graphic representation of enemy forces, personnel, and facilities in a specific situation. (DoD, IADB)

TARGET CATEGORY—A group of targets all of which serve the same function or can produce the same product.

TARGET COMPLEX—A geographically integrated series of target concentrations. (DoD NATO, CENTO, IADB)

TARGET CONCENTRATION—A grouping of geographically proximate targets. (DoD, NATO, IADB)

TARGET DATA INVENTORY—A basic targeting data base which provides standardized target data in support of the requirements of the Joint Chiefs of Staff, military departments, and unified and specified commands for target planning, coordination and weapons application. (DoD, IADB)

TARGET DENSITY—The number of elements per unit of area; target compactness; proximity to other targets.

TARGET DISCRIMINATION:—

a. The ability of a surveillance or guidance system to identify or engage one target while multiple targets are present.

b. That quality of a guidance system which enables it to distinguish a target from its background or between two or more targets in close proximity. (DoD, NATO, CENTO, IADB)

TARGET DOSSIERS—Files of assembled target intelligence about a specific geographic area. (DoD, NATO, CENTO, IADB)

TARGET ELEMENT—The basic unit of a target. Some targets consist of one element; for example, a single locomotive or bunker. Others consist of similar multiple elements; for example, a POL tank farm.

TARGET FOLDERS—The folders containing target intelligence and related materials prepared for planning and executing action against a specific target. (DoD, NATO, CENTO, IADB)

TARGET GRID—Device for converting the observer's target locations and corrections with respect to the observer target line to target location, and corrections with respect to the gun target line. (NATO, CENTO, IADB)

TARGET ILLUSTRATION PRINT—A single contact print or enlarged portion of a selected area from a single print, providing the best available illustration of a specific installation or point target. (NATO, CENTO, IADB)

TARGET INFORMATION SHEET—Brief description of the target, including technical and physical characteristics details on exact locations, disposition, importance and possible obstacles for an aircraft flying at low altitudes.

TARGETING—The process through which objectives are selected for attack and desired effects are determined based upon a stated mission, force posture and capabilities, aerospace doctrine, plans, concepts of operations, and target intelligence.

TARGET INTELLIGENCE—Intelligence which portrays and locates the components of a target or target complex and indicates its vulnerability and relative importance. (DoD, NATO, CENTO, IADB)

TARGET ISLAND—A geographical grouping of targets.

TARGET LIST—A listing of targets maintained and promulgated by the senior echelon of command. It contains those targets which are to be engaged by supporting arms, as distinguished from a "list of targets" which may be maintained by any echelon of command as confirmed, suspect, or possible targets for informational and planning purposes. (DoD, IADB)

TARGET MATERIALS—Graphic, textual, tabular, or other presentations of target intelligence primarily designed to support operations against designated targets by one or more weapons systems. Target materials are suitable for training, planning, executing, or evaluating such operations. (DoD, IADB)

TARGET PERISHABILITY—The possibility or probability that a target will change significantly during a specific period of time. A significant change is one where the target no longer exists (has moved or been dismantled) or the target has changed to the extent that it is no longer lucrative for strike.

TARGET PRIORITY—Sequential ranking of targets based on given criteria.

TARGET RESPONSE (NUCLEAR)—The effect on men, materiel, and equipment resulting from the explosion of a nuclear weapon. (DoD, NATO, CENT, IADB)

TARGET SELECTION CRITERIA—General or specific criteria used in the selection of target systems or specific targets. The criteria include concepts such as importance, cushion, depth, reserves, recuperation, vulnerability, dispersion, location, identification, and perishability.

TARGET SYSTEM—:

a. All the targets situated in a particular geographic area and functionally related.

b. A group of targets which are so related that their destruction will produce some particular effect desired by the attacker. (DoD, NATO, CENTO IADB)

TARGET SYSTEM COMPONENTS—A set of targets belonging to one or more groups of industries and basic utilities required to produce component parts of an end product, or one type of a series of interrelated commodities. (DoD, IADB)

TARGET VALUE SYSTEM—A system used by the JSTPS to determine the relative importance of enemy installations in accordance with national guidance.

THERMAL RADIATION—:

a. The heat and light produced by a nuclear explosion.

b. Electromagnetic radiation's emitted from a heat or light source as a consequence of its temperature. (DoD, NATO, CENTO, IADB)

THERMONUCLEAR WEAPON—A weapon in which high temperatures are used to bring about the fusion of light nuclei such as those of hydrogen isotopes (for example, deuterium and tritium) with the accompanying release of energy. The high temperatures required are obtained by means of fission. (DoD, NATO, CENTO, IADB)

TIME CONTROLLED TARGET—A target for which timing must be controlled.

TIME ON TARGET (TOT):—

a. Time at which aircraft are scheduled to attack or photograph a target.

b. The time at which a nuclear detonation is planned at a specified desired ground zero. (NATO, CENTO)

TIMER REFERENCE POINT (TRP)—A visually or radar significant ground fix point at which the timing sequence of the Low Angle Drogue Delivery (LADD) is initiated.

TIME URGENT TARGET—A target which may not be time dependent initially but becomes so once the decision has been made to execute an attack against it.

TOSS BOMBING—A method of bombing where the aircraft flies on a line toward the target, pulls up in a vertical plane, releasing the bomb at an angle that will compensate for the effect of gravity on the bomb. (DoD, IADB)

TRAIN BOMBING—A method of bombing in which two or more bombs are released at predetermined intervals from one aircraft as a result of a single activation of the bomb release mechanism in the aircraft.

(DoD, NATO, CENTO, IADB)

UNDERGROUND BURST (NUCLEAR)—The explosion of a nuclear weapon in which the center of the detonation lies at a point beneath the surface of the ground.

UNDERWATER BURST (NUCLEAR)—The explosion of a nuclear weapon in which the center of the detonation lies at a point beneath the surface of the water.

VULNERABILITY—Susceptibility of a target to destruction by available weapons. (DoD, IADB)

VULNERABLE AREA—An expression of the area of a target is vulnerable to the damage mechanism of a given weapon. (DoD, NESN, NFSN, IADB)

WEAPON ALLOCATION—The PREPLANNED distribution of the committed weapons over the target system to achieve the mission objectives.

WEAPON DELIVERY—The total action required to locate the target, establish the necessary release conditions, and maintain guidance to the target if required. It includes the detection, recognition, and acquisition of the target, the weapon release, and weapon guidance.

WEAPON EFFECTIVENESS—The statistical estimate of the expected results if a specific munitions employment, considering target vulnerability, munitions effects, target environment, damage criteria, delivery accuracy, external ballistics, and weapon reliability.

WEAPON RELIABILITY—The dependability of the warhead functioning properly.

WEAPON SYSTEM EFFECTIVENESS—A statistical estimate of the expected results of a specific munitions employment considering weapon effectiveness and the probability of weapon system arrival.

WITHHOLD (NUCLEAR)—The limiting of authority to employ nuclear weapons by denying their use within specified geographical areas. (DoD, IADB)

ZERO POINT—The location of the center of a burst of a nuclear weapon at the instant of detonation. The zero point may be in the air, on or beneath the surface of the earth or water, dependent upon the type of burst, and it is thus distinguished from ground zero. (DoD, IADB)

ZONE I (NUCLEAR)—A circular area, determined by using minimum safe distance as the radius and the desired ground zero as the center from which all armed forces are evacuated. If evacuation is not possible or if a commander elects a higher degree of risk, maximum protective measures will be required. (DoD, IADB)

ZONE II (NUCLEAR)—A circular area (less Zone I) determined by using minimum safe distance as the radius and the desired ground zero as the center, in which all personnel require maximum protection. Maximum protection denotes that armed forces personnel are in "buttoned up" tanks or crouched in foxholes with improvised shielding. (DoD, IADB)

ZONE III (NUCLEAR)—A circular area (less Zones I and II) determined by using minimum safe distance as the radius and desired ground zero as the center in which all personnel require minimum protection. Minimum protection denotes that armed forces personnel are prone on open ground with all skin areas covered and with an overall thermal protection at least equal to that provided by a two-layer uniform. (DoD, IADB)

Attachment 2

THE EVOLUTION OF TARGETING
(ADAPTED FROM THE ARTICLE......, JOHN GLOCK)

The choice of enemy targets is the most delicate operation of aerial warfare

Giulio Douhet 1921

The key to air power is targeting and the key to targeting is intelligence

Col John Warden 1990

Those who have written about or employed aerospace power have long recognized the importance of targeting and understood the successful application of airpower depends on targeting. This section traces the evolution of Air Force targeting.

WORLD WAR I

From their earliest days, aerospace forces have pursued the idea of the "strategic" application of airpower. German Zeppelin raids on London in 1917 are probably the first known uses of air forces beyond direct support of ground operations. While the material effects of these raids were minimal, the effects on the conceptual role of airpower were tremendous. During this period, the US developed its concept for "strategic bombing" against commercial centers and lines of communications. In November 1918, Maj. Edgar S. Gorrell developed the first strategic bombardment plan for the Air Service, American Expeditionary Force (AEF). Gorrell's objective was to "drop aerial bombs upon commercial centers and the lines of communications (LOC) in such quantities as will wreck the points aimed at and cut off the necessary supplies without which the armies in the field cannot exist." To achieve this result, planners required targets. To determine these targets, airmen systematically analyzed critical enemy industrial centers and LOCs to ascertain which should become targets. (Given the accuracy of bombing at this point, only installations needed to be identified). The ability to identify critical components at installation would not be needed until Vietnam. (Between 12 June 1918 and 11 November 1918 U.S. bombers dropped 275,000 lbs of bombs on rail yards, factories, bridges, other LOCs, command post, troop concentrations, etc.). However, the war ended before the AEF could fully execute the plan. The [WW I] U.S. Bombing Survey concluded that the Air Service needed to identify critical targets to support a systematic plan for air operations. The Survey stated:

The greatest criticism to be brought against aerial bombardment as carried out in the war of 1914-1918 is the lack of a predetermined program carefully calculated to destroy...those industries most vital in maintaining Germany's fighting force.

It recommended that:

A careful study should be made of the different kinds of industries and the different factories of each. This study should ascertain how one industry is dependent on another and what the most important factories of each are. A decision should be reached as to just what factories if destroyed would do the greatest damage to the enemy's military organization as a whole.

Another lesson from the war was that dedicated, trained individuals, knowledgeable of airpower, were needed to undertake this careful study. The Intelligence Section of the General Staff (G-2) created an Air Intelligence (A-7) subsection. 1st Lt Alfred T. Bellinger, a G-2/A-7 staff officer, reported that there were some who believed that the "work of air intelligence belonged properly to the Air Service. ...Supporters of this theory [believed] it was necessary for an Intelligence Officer to have technical knowledge of aviation for the proper performance of his duties." Immediately following WW I Gen Mitchell identified the need for [target] intelligence officers at the staff and unit level. He saw the need for these officers "to compile and maintain all information of value in the preparation of bombing missions, an indexed file of photographs, and a stock of maps and charts showing bombing targets and intelligence concerning them."

WW I showed that successful application of airpower requires a predetermined plan calculated to destroy the enemy's will and war sustaining capability. Achieving this goal requires systematic analysis to determine which targets, if destroyed, would do the greatest damage to the enemy. An organization with a constant focus on air targeting is needed to undertake this kind of systematic study. This organization needs to maintain files of information about potential targets, as well as requisite target materials. From the beginning, the Air Service took the lead in air targeting. It developed the first concepts, not only for the offensive use of air forces, but also for the intelligence support required.

INTERWAR YEARS

As a result of lessons from WW I, the Air Service/Corps recognized it needed to more fully develop its concepts for the employment of airpower. Through the interwar period, the Air Service Tactical School (ASTS)/Air Corps Tactical School (ACTS) continued to develop the concept of strategic bombing. The instructors recognized targeting was an integral part of bombardment. By 1926, many airmen considered bombardment the most important role for air power, and the predominance of bombardment led to an increasing emphasis on targeting. Maj. Donald Wilson, an instructor at the ACTS, believed that attacking a few critical targets would disrupt an enemy's economy. These targets, if successfully destroyed, would have a twofold effect. First, the enemy's industrial complex could not sustain its fielded forces. Secondly, the effect on the day-to-day lives of the civilian population would be so disruptive that they would lose faith with their government and military, and force the national leadership to sue for peace. According to then Lt. Haywood Hansell (one of two officers assigned to help Maj. Wilson), one of the principal tenets upon which the school based its strategic doctrine stated:

Proper selection of vital targets in the industrial/economic/social structure of a modern industrialized nation, and their subsequent destruction by air attack, can lead to fatal weakening of an industrialized enemy nation and to victory through airpower.

By the 1930s the Air Corps developed a doctrine based on the belief that airpower could achieve victory by breaking the enemy's will and capability to fight. It would accomplish this by:

Destroying organic industrial systems in the enemy interior that provided for the enemy's armed forces in the field; and paralyzing the organic industrial, economic, and civic systems that maintained the life of the enemy nation itself.

Although this concentration on strategic bombing to the exclusion of development of escort fighters was to later prove disastrous, the doctrine led to an even greater need for target intelligence. Maj. Gen Hansell, in his memoirs, stated that ACTS believed strategic intelligence was: "vital to the planning and conduct of strategic air warfare." He continues:

Much of the value of the bombing offensive, should there be one, would of necessity rest on intelligence data and the conclusions planners gleaned from it. In truth these specific questions were beyond the competence of the Tactical School. Strategic air intelligence on the major world powers would demand an intelligence organization and analytical competence of considerable scope an intelligence and complexity.

Yet during the lean years of the "all-pilot Air Corps," when the Air Corps was struggling for its survival, there was no time or inclination to train officers in combat intelligence. Despite the clear lessons of WW I, the Air Corps entered the Second World War without an intelligence organization capable of conducting systematic studies of potential enemies and recommending vital targets whose subsequent destruction would lead to victory. The Air Corps still relied on Army G-2 to maintain sufficient data and target materials to support both the planning and conduct of air operations.

WORLD WAR II

On the eve of WW II, the Army Air Corps had a well-developed doctrine, but Army G-2 was not providing the intelligence support needed to turn doctrine into operations:

The American airman entered the war with a rather well-developed body of doctrine on how the airplane should be employed...but it was evident from an early date that the [Army Air Force] AAF was poorly prepared for waging a strategic campaign against Germany, or any other enemy, because of the paucity of organized intelligence on the target itself.

In 1940, Gen Arnold recognized the Air Corps was not receiving the intelligence it needed to establish requirements or plan operations. He requested and received permission to establish an air intelligence organization under the Chief of the Air Corps. Then Maj. Hansell was the first Chief of the Strategic Air

Intelligence Section, A-2. His section performed economic-industrial-social analysis. It analyzed and described the vital and vulnerable systems, selected targets, and prepared target folders. In July 1941, Gen Arnold assigned Maj. Hansell to the new Air War Plans Division (AWPD). The initial effort of the Division was to prepare the Army air section of the Joint Board Estimate of United States overall Production Requirements. (The AWPD input was simply known as AWPD-1. While technically a requirements document, it was really a blueprint for our air operations plan against Germany).

However, when war began, the AAF still had inadequate intelligence to plan and conduct combat operations and lacked a systematic method for selecting targets. The Air Corps had made no provision for air intelligence training. General Eaker, Commander Eighth Air Force, reported in March 1942: "Intelligence represents the section of activity in which we are weakest." Colonel McDonald, Chief of Eighth Air Force Intelligence, recalled that no one provided intelligence "in any useful form at the beginning of the war--we went into the field empty handed in this respect." While there was an Air Intelligence Section, there was still no organization capable of performing the systematic analysis required for proper targeting and no trained target intelligence officers. There was also no database of potential targets or target materials to support the air forces.

During the fall of 1942, the air requirements plan (AWPD-42) against Germany was under discussion at the highest level, and as the discussion progressed, its limitations in the field of target analysis became readily apparent. The AAF had accumulated a vast amount of data on Germany, but no rational system for target selection existed. Gen Arnold established the Committee of Operations Analysts (COA) in December 1942 to overcome this shortfall. For the first time the United States had a single organization responsible for the collection and analysis of intelligence for the purpose of air target selection. Air planners used the COA's target selection as the basis for the Combined Bomber Offensive against Germany and the strategic campaign against Japan. This group eventually evolved into the first Joint Target Group, with the Deputy Assistant Chief of Air Staff for Targeting as its head. Also in 1942, the AAF created a school to train air intelligence officers. Another outgrowth of the attempt to find a systematic approach to target selection was the creation of a database of potential targets. It was called the Bombing Encyclopedia, (the Bombing Encyclopedia was the first effort to automate the handling of the vast amount of information needed to provide target recommendation for every country in the world) the forerunner of today's Basic Encyclopedia.

By 1944, most in the AAF recognized the importance of intelligence to air operations. Gen Hansell stated:

I believed foreign industrial analysis and targeting was the sine qua non of strategic air warfare. Without such intelligence and analysis there could be no rational planning for the application of airpower. Douhet's statement to effect that the selection of objectives and targets was the essence of air strategy was patently true.

Maj. General McDonald, USAF Director of Intelligence, was even more specific when he said: "target intelligence was the basic requirement, because: A Strategic Air Force is nothing more than a large collection of airplanes unless it has a clear conception of what to use its planes against." Just as the (WW I) Bombing Survey had, the United States Strategic Bombing Surveys (USSBS) emphasized the importance of target selection to the planning and conduct of operations. The USSBS stated:

The importance of careful selection of targets for air attack is emphasized by [our] experience. Our strategic intelligence...at the outset of the war was highly inadequate. ...[I]f a comparable lack of intelligence should exist at the start of a future national emergency, it might prove disastrous. The present shortage of trained and competent intelligence personnel give cause for alarm and requires correction.

Two World Wars showed that the proper selection of vital targets is critical to the successful application of airpower and is dependent on a systematic study of available intelligence. Without such intelligence and its systematic analysis there can be no rational planning for the application of airpower. An organization with a high degree of analytical competence is required to perform this targeting function. It requires competent, trained personnel who understand the capabilities and limitations of intelligence, as well as aerospace forces. These individuals must have access to a current database and the knowledge to use it.

KOREAN WAR

Five years after WW II the prophetic words of the USSBS were realized. The US did not possess the organization, intelligence personnel, database and target materials needed to support the application of aerospace forces on the Korean peninsula. (The advent of nuclear weapons led many to believe that targeting was not a required discipline. There was no need to analyze the enemy target sets when we were going to destroy whole cities. According to Dr. Futrell, in the late 1940s there was a belief in USAF Directorate of Intelligence that 'Targets should be working for the Directorate of Plans.' Much of the knowledge of the intimate relationship of air intelligence and air operations was lost during the rapid demobilization of the wartime intelligence force.) Prior to the outbreak of war, there was no organization in the Air Force maintaining and analyzing the North Korean target base. The existing database on North Korea was inadequate. In part this was due to the Far East Command's (FEC) lack of contingency plans for war with North Korea. A Far East Air Force's (FEAF) report highlights these shortfalls.

The probability of fighting in Korea largely had been overlooked in the years following WW II. As a result, we had practically no ready target intelligence. ...[We] found [ourselves] without a targeting system capable of fulfilling the requirements. ...However, an even more serious deficiency was the small amount of Korean targeting which had been accomplished. ...The latter stemmed from several basic causes, the most obvious of which was the small number of intelligence personnel who had been assigned to FEAF.

Only 53 targets in North Korea had target folders, and these were out of date. Also, there were no current target materials on Korean targets. There was even a lack of basic imagery products. The FEAF Bomber Command stated that the available imagery, when it did exist, was of poor quality.

The problem of inadequate numbers of trained intelligence personnel to support the targeting function continued throughout the war. Two separate studies (Barcus and Stearn) were conducted to evaluate the effectiveness of the Air Force in Korea. Both indicated that the outbreak of the war had created an immediate shortage of intel personnel and pointed out that inadequate training made these shortages more acute. The shortage was so acute that the FEAF had to draft flying officers to perform intelligence functions. As late as July 1952, the FEAF Bomber Command "lacked sufficient personnel to handle any large day-to-day quantity of targets." The FEAF Report states:

The Korean campaign provided more than enough evidence to bolster the contention that neglect of intelligence training during peacetime is a serious mistake, if that point had not already been made powerfully clear at the outset of WW II. The FEAF was woefully lacking in competent Combat Intelligence Officers.

General Headquarters Far East Command (GHQ FEC) assumed responsibility for targeting. The chief of staff established the GHQ Target Group on 14 July 1950 and made it responsible for target nominations. However, the GHQ Target Group was not capable of performing this task. The work of this group was neither systematic nor thorough and resulted in information of questionable value. Of the 220 primary and secondary targets the group nominated, twenty percent did not even exist. The remainder were often unsuitable for attack by aircraft. Finally, of the targets that did exist and that were suitable for attack by aircraft, many were not supported with adequate imagery or information. Eventually, the FEAF took on a greater portion of the target nomination process and gradually became the theater targeting body, responsible for nominating targets that were the basis for air campaigns meeting the needs of the FEC. However, it was two years before there was a fully integrated joint targeting effort.

The lack of trained analysts affected two additional areas: combat assessment and weapon recommendations. The FEAF Report on the Korean War indicates that there were few studies conducted on the results obtained from our bombing. It states: "If a more extensive effort had been devoted to [combat assessment], a more accurate appraisal of the value of [our] target plans would have resulted." The report also indicates there was little effort to make weapon recommendations. Just ten days before Armistice the FEAF Director of Intelligence was finally able to establish a Vulnerability Division to provide effective and economical weapon recommendations. If this Division had been established earlier it undoubtedly would have contributed to a more efficient accomplishment of FEAF's mission in the Korean War.

FEAF lessons learned stated:

Although we had failed to stockpile targeting materials on Korea prior to the outbreak of hostilities, a greater initial deficiency was a lack of a targeting system. ...Our hastily improvised targeting program...suffered from a lack of trained and experienced intelligence officers. ...[This] resulted in a lack of sufficient enemy reaction studies, and an inability to provide complete weapon recommendations. ...The inability to perform these vital targeting functions caused us to over-estimate the results of several air campaigns.

It went on to say that:

Good target research must include physical vulnerability studies and weapons selection recommendations. [And that] a truly effective targeting program must...be initiated before fighting starts.

Experiences gained during the Korean Conflict reinforced the lessons learned in both World Wars--the proper selection of vital targets is critical to the successful application of airpower. Selecting these targets requires trained, experienced personnel familiar with both the operations and intelligence worlds. In an effort to correct deficiencies existing at the start of the Korean Conflict, the Air Force created the targets officer career field in 1954. It enlarged the scope of the database of potential targets to include many more potential enemies. Also, at the request of the JCS, the Air Force became the executive agency for the DoD Air Target Materials (ATM) Program (ATMP) in 1953 in order to ensure the adequacy of air targeting materials.

VIETNAM CONFLICT

Unfortunately, much of the progress the Air Force made in the fifties was lost in the early sixties. One of President Kennedy's first acts was to restructure the DoD to make the department more efficient and flexible. One way of doing this was to centralize functions that were not service specific, one of which was intelligence. In 1962 the DIA took over much of the intelligence work previously performed by the services, including maintenance of the targeting database. DIA also became responsible for the ATMP and the Tactical Target Materials Program (TTMP). Unfortunately DIA (and the Air Force) largely ignored conventional targeting applications in the nuclear age. The Air Force would soon feel the results of both the centralization of intelligence and the neglect of conventional operations.

Some believed the centralization of the targeting functions within a national agency was imprudent. Gen Keegan, the Seventh Air Force Deputy Chief of Staff for Intelligence 1968-1969, said: "Years ago, the mission of targeting was taken away from the Department of the Air Force and passed to DIA, where it simply died." At the beginning of our involvement in Vietnam the Air Force did not have an adequate targeting organization to support our combat operations. As one lesson learned states:

The targeting function is an essential element in the effective employment of fighting forces. ...[T]he Second Air Division intelligence organization could not provide adequate planning and execution support to the rapidly escalating air operations.

The situation was very similar to that of the Korean Conflict. The BE provided targeteers and planners with basic infrastructure and industrial installations. Pacific Command planners were able to identify ninety-four targets in North Vietnam, which were arranged into four attack options in an OPlan. Each option provided for escalation of the conflict. But the objectives of the war were constrained, and the US was forced to attack "in-country" targets. Because the Air Force did not have a targeting organization capable of supporting this:

[Military Assistance Command Vietnam] MACV J-2 developed its own organization, the Target Research and Analysis Center (later renamed the Combined Intelligence Center, Vietnam (CICV)), to accomplish the in-country targeting task."

During the battle for Khe Sanh (Operation NIAGARA), MACV relinquished control of targeting, and the Air Force created an ad hoc targeting organization to effectively use air assets. Seventh Air Force Deputy Chief of Staff for Intelligence (DCS/I), augmented by TDY personnel, established an intelligence control center. This center represented the first major Air Force contribution to the in-country targeting effort. In March 1968 the Air Force recalled the TDY personnel and terminated the operation of the intelligence control center, effectively conceding de facto control of targeting back to MACV. This again limited the Air Force to providing on call fire support to the ground forces in Vietnam, just as in Korea. "The Air Force quickly found itself woefully short of targeting personnel. By 1969 [the] Air Force had just about exhausted its cadre of experienced targeteers fighting the war. The void was filled with "CBPO" targeteers with little or no experience."

The war effort was negatively impacted by a shortage of intelligence personnel and their lack of training:

Although the Air Force had been in [South East Asia] SEA since late 1961, adequate intelligence personnel resources were still unavailable when the rapid buildup began. ...The buildup began at a time when the Air Force was actually reducing manpower resources in response to budgetary and gold flow constraints. ...[T]he lack of adequate formal and technical training for intelligence personnel adversely affected intelligence in SEA.

There were many positive lessons from Vietnam. Air Force doctrine recognized that target intelligence is essential to aerospace operations:

The role of intelligence support in the effective employment of tactical air forces is of critical importance. Targeting is the key function and includes exploitation of all intelligence sources for target development, material production, target analysis, recommendations for strike and strike assessment.

Air Force Intelligence also learned critical lessons. It realized that it was not sufficient to merely assign intelligence officers to targeting positions; intelligence officers needed formal targeting training. In 1974 the Air Force established the Armed Forces Target Intelligence Training Course, which trained Army, Navy and Air Force officers in the capabilities and limitations of all services' weapons systems supporting air operations. It also trained students in analytical methodologies for selecting, prioritizing and recommending targets meeting the commander's objectives and guidance. Graduates of this course were unique because they possessed an understanding of air operations as well as intelligence operations

THE GULF WAR

Building on nearly eight decades of history and lessons learned, the Air Force entered the Gulf War more prepared to apply aerospace forces than at any time in the past, but even with these preparations problems occurred. Air Force targeting officers did not provide the support that decision makers, planners, and aircrews required. Some of these problems were institutional, some resulted from changing concepts of airpower employment, and others were systemic within the intelligence bureaucracy.

In 1990, an Air Force targeting element supported each Unified Command. In February 1990 USCENTCOM directed its Air Force component (9th Air Force/CENTAF) to update the air plan for OPLAN 1002-90. In support of this request the 9th Tactical Intelligence Squadron (TIS) Target Intelligence Division (now the 609 AIS) began target development for the draft OPLAN. Air Force targeting officers took the objectives the air planners provided and identified target systems to meet them. They researched known installations and developed lists of potential targets and used these lists to produce the Iraqi Target Study published on 15 June 1990.

Two recurring problems hampered these efforts. First was the inadequacy of the installation database. DIA maintained a worldwide installation database known as the Automated Installation File (AIF) to store, manipulate and retrieve target intelligence. Ideally, it would contain information on every installation or place of potential military significance. However, 40% of the targets struck during the Gulf War were not in the database in July 90. In addition to listing installations, the AIF could contain vital targeting information such as construction data and identification of critical components. Unfortunately, many of its records fell far short of providing the information necessary for accurate targeting.

The second problem the 9TIS targeting staff encountered was a lack of necessary imagery and supporting target materials. Only 90 of the 218 targets the 9TIS identified had imagery. Of these, only 30 had target materials. Of the targets actually struck during the war, only eleven percent had target materials on 2 Aug 90. In a 29 Aug 90 DIA memo to the Deputy Director for Foreign Intelligence, the DIA Chief of Targets acknowledged that DIA had "issues to resolve and problems to fix [with availability of target materials] after the crisis." In addition to the basic shortage of target materials at the beginning of the crisis, many were of questionable utility due to their currency. The ATTG was the basic target material at this time. Figures taken from CENTAF (15 Jun 1990) and CENTCOM (27 Jun 1990) target list and the Consolidated Tactical Target Materials Catalog. The average date of production was 1982, with the oldest produced in June 1973.

Despite these problems, the contributions of Air Force targeteers were significant. Ninety-seven percent of the targets in the 9TIS Iraqi Target Study (produced a month and a half prior to the Iraqi invasion) were struck during DESERT STORM. By comparison, only thirty percent of the targets in the July 1990 CENTCOM Joint Target List and ninety-three percent of the 12 Aug 90 Air Staff target list (the well-known list produced by CHECKMATE) were struck during the war. Looking at the issue from the stand point of what percentage of the total targets struck were identified in various list prior to the war, one finds that the percentages for the 9TIS, CENTCOM and the Air Staff are forty-three, twenty-two, and nineteen respectively. More than four months prior to the invasion, the 9TIS identified information and imagery shortfalls that would impact combat operations if not satisfied.

Air Force targeting officers were also available to support planners in the area of weapon recommendations and critical element analysis. They recommended the optimum mix and number of weapons, fuzing, and critical elements throughout the war, but in some cases planners chose to disregard this information. The planners often thought the recommendations were too conservative.

Three examples should illustrate this point. In Aug 90 CENTAF targeting personnel recommended that bridges only be attacked by aircraft using PGMs. Initially, this advice was ignored, but based on unacceptable results, planners shifted to using PGMs. Also in August, targeting officers estimated a particular target would require more PGMs than planners thought it should. This target was struck but never penetrated during the war. At the end of the war it was fully functional. In Jan 93, as part of Operation Southern Watch, this same target was struck using the number of weapons recommended by the targeting staff, resulting in the functional destruction of the facility. Finally, on 19 Jan 91, a targeting officer recommended using CBU-89s and CBU-87s against mobile SCUDs. Following the recommended strike, there was a break of sixty hours before the Iraqis launched another SCUD against Israel and more than five days before there another mass launch. However, planners switched back to PGMs in an effort to achieve physical destruction instead of using an area denial strategy to achieve a functional kill. There is still no evidence that the "SCUD hunting" mission with PGM's achieved a single kill. All examples are based on the experiences of the author. The second example is collaborated by Col Deptula in an interview conducted by Dr. Berry Watts, the third is recounted in the Department of Defense, Final Report to Congress on the Conduct of the Persian Gulf War (Washington, D.C.: GPO, 1992), 166.

Targeting officers were not as successful in providing essential combat assessment information. One reason for this was a lack of training. The former Armed Forces Targeting Course provided only five hours of instruction on combat assessment. Exercises also provided little training.

DESERT STORM raised fundamental questions about the effectiveness of targeting. Targeting planners were not always correct and did not provide the best support possible.

TODAY

The global geopolitical situation has changed, resulting in the downsizing and restructuring of the military services. The Air Force decided to eliminate all of the functional career fields, including the targeting officer. The decision was based on budgetary and manpower constraints and the rationale that it is more cost efficient to maintain generalists at the expense of trained specialists.

Since the end of the Gulf War many have written about the war's lessons. Most authors have addressed how precision weapons and stealth platforms have altered the nature of warfare. This masks another more critical lesson -- the importance of targeting. Greater precision requires even greater and more detailed target analysis. In each conflict weapon accuracy has improved. An enduring lesson learned about delivery accuracy during the last eight decades is that the greater the weapons' accuracy the more accurate targeting must be.

In 1992 Congress "encourage SECDEF, heads of military services, Chairman of Joint Chiefs of Staff, and Director of DIA to make resources available for a Joint Target Training Program." (Congress, Senate, Select Committee for Intelligence, July 1992.) For the first time since 1918, the Air Force has not taken the lead in a targeting program. Although the Air Force has the greatest experience in joint air targeting and the preponderance of air assets, it has taken a back seat in the future of joint targeting.

CONCLUSION

The Air Force offers the quickest, longest range, most flexible force available to the nation. As we continue to draw down, our power projection capabilities will become even more vital in protecting U.S. interests. To rapidly deploy and sustain sizeable combat air power from home bases to crisis hot spots around the world, aircrews require intelligence tailored to the decisive application of air power. The theater battle management system of the future will integrate all intelligence inputs, disseminate real-time updates to the ATO, and provide the feedback required to affect tomorrow's ATO. The intelligence systems currently being fielded and those on the horizon, coupled with an invigorated intelligence training concept, will provide capabilities far surpassing that available in any previous conflict. But most importantly, those systems will required trained, capable intelligence analysts, planners, and targeting professionals to provide quality support to combat air operations whenever and wherever required.

Attachment 3

SOURCES OF INTELLIGENCE

A3.1. Human Intelligence (HUMINT). HUMINT refers to all information obtained directly from human sources. It includes a wide range of activities from direct reconnaissance and observation to the use of informants and spies. HUMINT may provide such information as insights into adversary plans and intentions for target development, adversary deliberations and decisions for developing our own objectives, research and development goals and strategies, blueprints for weaponeering, etc. Some intelligence requirements can best be satisfied by human source exploitation.

A3.1.1. HUMINT includes overt, sensitive, and clandestine activities and the individuals who exploit, control, supervise, or support these sources.

A3.1.1.1. Overt activities are performed openly without concealment. While some aspects may be classified, the overall activity is generally easily detected, or the sources are exploited in an open but discrete manner. Some overt HUMINT activities are: conventional programs for the interrogation of ÈmigrÈs, refugees, escapees, and prisoners of war; debriefing aircrews and legal travelers; and programs to exploit open publications.

A3.1.1.2. Sensitive activities fall between overt and clandestine. Because their disclosure would be detrimental to the best interests of the United States, they require special protection from disclosure, as well as concealment of the sponsor's identity.

A3.1.1.3. Clandestine activities must be conducted so that both the existence of the operation itself and the identity of the sponsor are secret.

A3.1.2. Advantages of HUMINT:

- Can be used to reveal enemy plans and intentions and uncover scientific or weapon developments before they are used or detected by other technical collection systems
- Can provide documentary evidence of enemy activities
- Relatively cost effective
- May provide coverage in areas beyond the capabilities of other sources, such as detailed descriptions of underground facilities or those located below jungle canopy, as well as internal facility arrangements
- Can reveal construction characteristics for vulnerability estimates
- Can determine production capabilities and impact of facilities on enemy military and industrial needs
- Yields information on the sources of raw materials, equipment, and necessary transportation for systems analysis
- May reveal direct and indirect relationships between facilities
- Can give near-real-time target intelligence via radio transmission
- Can cover targets against which sensor programs are restricted by political restraints
- Targeteer can use it to refine or revise intelligence estimates based on other sources of information; helps the analyst learn identification and functions previously unidentified, as well as give direct and indirect effects of airstrikes during hostilities

A3.1.3. Limitations of HUMINT:

- Time lag between collection, reporting, and verifying some information can be so long AND render it useless
- Collection success cannot be predicted with certainty
- May be politically sensitive
- Dissemination and fusion of information into targeting channels is often inadequate and difficult to accomplish
- Determining reliability of the source and verifying the information is often very difficult

A3.2. Signals Intelligence (SIGINT) . SIGINT is a category of intelligence comprising, either individually or in combination, all communications intelligence (COMINT), electronics intelligence (ELINT), and foreign instrumentation signals intelligence, however transmitted. It is derived from foreign communications and electronics signals in two principal categories: COMINT, which is derived from the intercept of foreign communications; and ELINT, which is derived from the analysis of foreign noncommunications and electromagnetic radiation emitted from other than nuclear detonations or radioactive sources.

A3.2.1. NSA is responsible for the US SIGINT program. Each military service has a service cryptological agency, operationally directed by NSA through the Central Security Service (CSS), to ensure missions are properly assigned and duplication of effort is avoided. In the Air Force, this mission is assigned to Air Intelligence Agency (AIA). The Army Intelligence and Security Command (INSCOM) and the Naval Security Group (NSG) make up the remaining agencies of the military NSA and CSS structure. The Director of NSA also serves as Chief of CSS.

A3.2.2. SIGINT has many uses, but its application requires a thorough knowledge of the product. Order of battle depends heavily on correlation and analysis of COMINT and ELINT. Mission route planning requires current intelligence on enemy defensive positions and capabilities. Targets can be detected and located through airborne direction finding techniques. Intelligence concerning enemy operational plans may be obtained through signal analysis or cryptologic procedures. Confirmation of other types of intelligence can be made by targeting personnel with the aid of SIGINT reports. Finally, post strike or attack data and damage resulting from missions may also be obtained.

A3.2.3. Advantages of SIGINT:

- Potential for almost instantaneous information
- Can sometimes reveal specific information on enemy units
- Levels of activity and significant changes in these levels can often be determined
- Organizational structure and order of battle may be obtained
- Can cue other systems
- Equipment capability can be learned
- Emitter location can be approximated or pinpointed (dependent on accuracy capability of the system)
- Site function can be determined

A3.2.4. Limitations of SIGINT:

- Data may be denied by use of secure communications
- False information may be passed by the enemy for deception purposes
- Collection subject to atmospheric conditions
- Locations derived from SIGINT may be imprecise
- Specially configured collection platforms required
- Use of SIGINT collection platforms requires extensive coordination between collectors and users

A3.3. Measurement and Signature Intelligence (MASINT) . MASINT is obtained by quantitative and qualitative analysis of data (metric, angle, spatial, wave length, time dependent, modulation, plasma, and hydromagnetic) derived from sensing instruments other than those generally used for communications, electronics intelligence, or imagery collection.

A3.3.1. MASINT includes but is not limited to the following disciplines:

- Radar intelligence (RADINT)
- Nuclear intelligence (NUCINT)
- Unintentional radiation intelligence (RINT)
- Acoustic intelligence (non compressible fluids (ACINT), compressible fluids (ACOUSTINT)
- Electro-optical intelligence (ELECTRO-OPTINT)
- Event-related dynamic measurement photography (DMPINT)
- Debris collection
- Laser Intelligence (LASINT)

A3.3.2. Telemetry Intelligence (TELINT) is technical information and intelligence information derived from the intercept, processing, and analysis of foreign telemetry and is a special category of signals intelligence. TELINT gathers quantitative data on foreign missiles and space and aerodynamic vehicles. TELINT and other foreign instrumentation signals (FIS) collection needs are expressed as MASINT requirements.

A3.3.3. The term MASINT refers to the above categories of special sensor disciplines. The term "measurement" refers primarily to data collected for the purpose of obtaining finite metric parameters. For the most part, the characteristics of collection instruments used are irrelevant to the data. Typical examples of data are reentry vehicle trajectory, beta, and drag history. The term "signature" refers primarily to data indicating the distinctive features of phenomena, equipment, or objects as they are sensed by the collection instrument. The signature is used to recognize the phenomena, equipment, or object when their distinctive features are detected.

A3.3.4. Advantages of MASINT:

- Can provide cues for other collection sensors or strike systems
- Potential for near instantaneous display capability exists
- Information can be obtained from the periphery of areas of interest
- Because it works in different parts of the electromagnetic spectrum, MASINT detects information patterns not previously exploited by other sensors

A3.3.5. Limitations of MASINT:

- Sources and information are technical and difficult to use
- Subject to deception
- Full exploitation is costly, requires extensive support facilities, and may require near continuous coverage and extensive coordination among participants
- Source locations may be imprecise

A3.4. Unattended Ground Sensors (UGS).

A3.4.1. The conflict in Southeast Asia brought about the development and use of this unique intelligence source. These sensors were developed using technology derived from sonobuoys used by the Navy for antisubmarine warfare (ASW) and from intrusion detectors developed for the Army. Sensor technologies are typically categorized as acoustic, seismic, magnetic, electromagnetic, or electro-optical.

A3.4.1.1. Acoustic sensors sense the acoustic energy (sound waves) emitted by a potential target. They allow analysts to calculate the target's position by measuring the time of arrival of sound waves at several known sensor locations; to identify or classify targets based on the emitted acoustic energy; or to monitor sounds or conversations.

A3.4.1.2. Seismic sensors detect or measure seismic disturbances generated by moving vehicles or personnel. They can be used to cue other, higher resolution sensors (for example, acoustic or electro-optical sensors) and identify or classify targets.

A3.4.1.3. Magnetic sensors detect changes in the ambient magnetic field caused by the movement or presence of metallic objects. Their range is extremely short, but they can be used to cue other, higher resolution sensors and to identify or classify targets.

A3.4.1.4. Electromagnetic sensors detect target emitted electromagnetic radiation. Such sensors depend on target self-emission, target motion, or conversion of mechanical disturbance into electromagnetic radiation.

A3.4.1.5. Electro-optical sensors systems image potential targets to detect, locate, and identify them. The most common are unattended infrared (IR) ground sensors, although sensors detecting in the visible light end of the spectrum have also been investigated.

A3.4.2. Advantages of unattended ground sensors:

- Great growth potential as intelligence sources
- Can detect movement and activity patterns not previously exploited by other sensors
- Can detect and relay actual sounds
- Have a nearly instantaneous intelligence capability
- Cue other sensors

A3.4.3. Limitations of unattended ground sensors:

- Must be placed by other systems
- Environment affects the sensor
- Expensive, sophisticated, and secure relay equipment is required

- A sophisticated analysis support system is required
- Sensors must be concealed

A3.4.4. Unattended sea sensors can provide valuable support to tactical air forces conducting sea interdiction and reconnaissance or surveillance operations. Potential sea sensor roles, advantages, and limitations are generally the same as those for unattended ground sensors.

A3.5. Imagery. Collectively, imagery is the representation of objects reproduced optically or electronically on film, electronic display devices, or other media. Imagery comes from visual photography, radar sensors such as sidelooking airborne radar (SLAR), infrared sensors, lasers, and electro-optics. While each sensor operates at different spectrum frequencies and each type of imagery has distinctive characteristics, the advantages and limitations of each are similar.

A3.5.1. Advantages:

- A variety of platforms and media is available
- Capable of pinpoint target positioning
- Activity can be detected
- Order of battle can be counted
- Target characteristics (physical or environmental) can be studied in detail
- Large area collection possible
- Excellent resolution possible
- Highly credible because it can be seen by the user

A3.5.2. Limitations:

- Except for radar, imagery quality normally degraded by darkness, adverse weather.
- Subject to deception or concealment techniques
- Requires extensive support facilities
- Can be expensive
- Subject to misinterpretation or misidentification
- Situation represented on the image may exist only for the instant it was captured

A3.6. Scientific and Technical (S&T) Intelligence . This is the product resulting from collecting, evaluating, analyzing, and interpreting foreign scientific and technical information. It covers foreign developments in basic and applied research and in applied engineering techniques; and scientific and technical characteristics, capabilities, and limitations of all foreign military systems, weapons, weapon systems, and materiel, the research and development related thereto, and the production methods employed for their manufacture

A3.6.1. Advantages:

- The most accurate intelligence available on capabilities and characteristics of foreign weapon systems
- May be used to determine systems capabilities

- Engineers, scientists, and technical experts intimately familiar with the subject being investigated

A3.6.2. Limitations:

- May be extremely limited or inaccurate on new systems or systems to which there has been no hands-on access
- Prolonged analysis may be required
- Capabilities do not necessarily indicate intentions

A3.7. Open Source Literature . Newspapers, magazines, books, and foreign broadcasts make up the greatest volume of intelligence materials. Telephone directories, films, maps, and charts are also useful.

A3.7.1. Advantages:

- Often presents an "insider's" view.
- Frequently provides a source of pictures and information not obtained from any other source
- Gives insight into another's thought processes and intentions
- May be the most timely information available
- Timeliness

A3.7.2. Limitations:

- Materials (particularly military and scientific journals) often represent an idealized rather than a real picture of a capability that is aspired to rather than possessed. However, such materials can provide a window into the future, if this caution is kept in mind.
- Censorship or other motivations limit promulgation of military related information
- Deception is possible
- Translations may be needed, which often causes a delay in using the information
- Significant information may be overlooked in the high volume of material to be processed

Attachment 4

TARGETING AND INTERNATIONAL LAW

A4.1. Introduction. During planning, targeting personnel must contend with two external sources of restrictions on weapons and target selection. First, and most basic, are the constraints imposed by international law. Second are other constraints imposed by higher headquarters for military or political reasons. This attachment concerns itself solely with the restrictions on weapons and targeting imposed by international law.

A4.2. General Restrictions on Air Bombardment: The Immunity of Civilians.

A4.2.1. Protection of the Civilian Population and Civilian Objects. The civilian population as such, as well as individual civilians, may not be made the object of attack. Acts of violence intended primarily to spread terror among the civilian population are prohibited. Neither may civilian property that is not a military objective be the object of attack.

A4.2.1.1. Non-participation in Hostilities . Civilian immunity carries with a strict obligation on the part of civilians not to take a direct part in hostilities--they must not become combatants. Taking a direct part in hostilities means engaging in acts of war directed toward enemy personnel or materiel. Civilians who take part in fighting (whether singly or as a member of a group) become combatants and lose their personal immunity.

A4.2.1.2. Requirement to Distinguish . The requirement to distinguish between combatants and civilians and between military objectives and civilian objects imposes obligations on all the parties to a conflict. This is true whatever the legal status of the territory on or over which combat occurs. For example, civilians may not be used in an attempt to render an area immune from military operations. Also, civilians may not be used to shield a defensive position, to hide military objectives, or to screen an attack. Neither may they be forced to leave their homes or shelters in order to disrupt the movement of an adversary.

A4.2.2. Military Objectives. Military attacks must be directed only against military objectives. Military objectives are those objects which by their nature, location, purpose, or use make an effective contribution to military action and whose total or partial destruction, capture, or neutralization in the circumstances offers a definite military advantage.

A4.2.2.1. Many objects are clearly military objectives --for example, the enemy's military encampments or armament (such as military aircraft, tanks, antiaircraft emplacements, and troops in the field). Factories, workshops, and plants that directly support the needs of the enemy's armed forces are also generally conceded to be legitimate military objectives.

A4.2.2.2. Controversy exists over whether, and under what circumstances, other objects such as civilian transportation and communications systems, dams, and dikes can properly be classified as military objectives. Modern transportation and communications systems are deemed military objectives because they are used heavily for military purposes in intense conflicts.

A4.2.2.3. However, the inherent nature of an object is not controlling. Even a traditionally civilian object (such as a civilian house) can be a military objective when it is occupied and used by military forces during an armed engagement. The key factor is whether the object makes an effective contribution to the adversary's military action, so that its capture, destruction, or neutralization offers a definite military advantage in the circumstances ruling at the time.

A4.3. Precautions in Attack. Only a military objective is a lawful object of attack. Therefore, constant care must be taken when conducting military operations to spare nonmilitary objects and persons, and positive steps must be taken to avoid or minimize any civilian casualties or damage. The principle of proportionality must always be followed, which prohibits an attack when the expected collateral civilian casualties or damage to civilian objects is excessive or disproportionate to the military advantage anticipated by the attack.

A4.3.1. Types of Precautions. The extent of danger to the civilian population varies with the type of military objective attacked, the type of terrain, the type of weapons used, the kind of weather, and whether civilians are nearby. It also depends on the combatant's ability and mastery of bombardment techniques, the level of the conflict, and the type of resistance encountered during the attack. Therefore the following steps must be taken:

A4.3.1.1. Identification of Military Objectives. Initially, those who plan or decide upon an attack must do everything feasible under the specific circumstances at the time to ensure military objectives, and not civilians or civilian objects, are in fact being attacked. Sound target intelligence enhances military effectiveness by showing that the risks undertaken are militarily worthwhile.

A4.3.1.2. Incidental Civilian Casualties Must Be Minimized. Attacks are not prohibited against military objectives even though they may cause incidental injury or damage to civilians. In spite of precautions, such incidental casualties are inevitable during armed conflict.

- This incidental injury or damage must not outweigh the expected direct military advantage. That is, the potential military advantage must be balanced against the probable degree of incidental injury or damage to civilians. If an attack is carried out efficiently, using the principle of economy of force, against a military installation, it would not be likely to violate this rule.
- On the other hand, if the attack were directed against objects used mainly by the civilian population in an urban area (even though they might also be military objectives), its military benefits would have to be carefully weighed against the risks to civilians.
- Required precautionary measures are reinforced by traditional military doctrines, such as economy of force, concentration of effort, target selection for maximization of military advantage, avoidance of excessive collateral damage, accuracy of targeting, and conservation of resources.

A4.3.1.3. Cancellation or Suspense of Attacks in Case of Mistake. Target intelligence may be found to be faulty before an attack is started or completed. If it is apparent that a given target is not a military objective, or that the target is under the special protection of international law, the attack must be canceled or suspended. An example of such special protection would be a hospital protected under the 1949 Geneva Conventions.

A4.3.1.4. Warning Requirement. Under the Hague Regulations, a warning must be given prior to bombardment, when circumstances permit, to permit the civilian population an opportunity to avoid injury. The "Hague Rules", written at the Hague Peace Conference of 1907, deal largely with how to fight an enemy who is in the field, and is still fighting, while the Geneva Conventions deal chiefly with the respect due our enemy, who is no longer able to fight, as well as treatment of civilians and civilian objects. If civilians are unlikely to be affected by the attack, the warnings need not be given. A general warning may satisfy this requirement, because a specific alert could jeopardize the attack force or the mission.

A4.3.2. Prohibition of Attack on Undefended Areas. Under the Hague Regulations, towns, villages, dwellings, or buildings that are undefended may not be attacked or bombarded. An undefended place is any inhabited place near, or in, a zone where opposing armed forces are in contact, and which is open for occupation by an adverse party without resistance.

A4.4. Separation of Military Activities.

A4.4.1. International law generally gives civilians "immunity" from attack during armed conflict. However, the parties to a conflict must also take all the precautions practical to protect their own civilian population, individual civilians, and civilian objects. For example, they should remove civilians from military objectives and avoid locating military objectives in or near densely populated areas.

A4.4.1.1. Under the 1949 Geneva Conventions, safety zones or demilitarized zones may be created between the parties of the conflict. Although the creation of such zones is unlikely if past experience is any indication, if created they would be an effective measure to enhance protection of a state's own civilian population.

A4.4.1.2. Under these rules, persons who are combatants are required to wear uniforms, and facilities such as hospitals should be clearly marked. Similarly, international law also requires belligerents to locate military objectives away from hospitals and not to use civilians to shield military objectives from attack.

A4.4.2. Result of Failure to Separate Military Activities. A state's failure to segregate and separate its own military activities and to avoid placing military objectives in or near a populated area may greatly weaken protection of its civilian population. Such protection is also compromised when civilians take a direct part in hostilities or are used unlawfully in an attempt to shield attacks against military objectives .

A4.5. Special Protection. In additional to the general rules for protecting civilians and civilian populations, there are specific rules for protecting certain persons and facilities. Under the 1949 Geneva Conventions, the following persons and objects must be protected from attack:

A4.5.1. Wounded and Sick, Medical Units and Hospitals, and Medical Means of Transport.

- Hospitals and other fixed or mobile medical establishments.
- Medical personnel and chaplains.
- Medical transport.
- Medical aircraft, when flying at agreed times on agreed routes.
- Hospital ships and, to the extent possible, sick bays of warships.
- Wounded, sick and shipwrecked persons must not knowingly be attacked, fired upon, or unnecessarily prevented from discharging their proper function. However, the incidental injury of personnel or damage to objects that are at, or near, a military target which is being attacked by fire, gives no just cause for complaint.

A4.5.2. Religious, Cultural, and Charitable Buildings and Monuments. Because they are not used for military purposes, buildings devoted to religion, art or charitable purposes, as well as historical monuments, may not be made the object of air bombardment. However, combatants have a duty to identify such places with distinctive and visible signs. When such buildings are used for military purposes, they may qualify as military objectives and may be attacked. Lawful military objectives are not immune from attack because they are located near such buildings, but all possible precautions must be taken to spare the protected buildings.

A4.5.3. Prisoner of War (PW) Camps. Prisoners of war may not be the object of attack. They may not be kept in a combat zone or used to render an area immune from military operations. When military considerations allow it, prisoner of war camps are identified by the letters "PW" or "PG" placed so they are clearly visible from the air. The use of PW camp markings for any other purpose is prohibited.

A4.6. Weapons: The Distinction Between an Unlawful Weapon and Unlawful Use of a Weapon. International law may prohibit completely the use of a specific weapon or may prohibit a specific use. A weapon is illegal *per se* if international law has forbidden its use in all circumstances. Poison as a gas, as a coating on munitions, or as a contaminant of water is an example of such an illegal weapon. However, any weapon may be used unlawfully; for example, firing a rifle at civilians or at combatants who have surrendered.

A4.7. General Principles Applicable to Weapons.

A4.7.1. Unnecessary Suffering. It is forbidden to employ any method or weapon of warfare which causes superfluous injury or unnecessary suffering. This firmly established rule, incorporated into the Hague Regulations, is a concrete expression of the general principles of proportionality and humanity. All weapons cause suffering. Whether particular weapons or methods of warfare cause unnecessary suffering (and hence are unlawful *per se) is* best determined by the practice of states. The critical factor is whether the weapon has been designed, or is used, so that it will cause suffering or aggravation of wounds as a separate element in the attack, and not the degree of suffering itself. Treaties banning specific weapons, such as gas and toxin weapons, also give specific content to this principle. The rule against unnecessary suffering also prohibits the infliction of suffering for its own sake, or for mere indulgence in cruelty. International law has condemned the use of expanding bullets against combatants and determined that it is illegal *per se* to use:

- Projectiles filled with glass or other materials inherently difficult to detect medically
- Any substance on projectiles that tends unnecessarily to inflame the wound they cause
- Irregularly shaped bullets. It is illegal to score the surface, or file off the ends of the hard cases, of bullets, so that they will expand upon contact and thus aggravate the wound they cause

A4.7.2. Indiscriminate Weapons. The law of armed conflict also prohibits the use of any weapon that cannot be directed at a military target. However, a weapon is not unlawful simply because its use may cause incidental civilian casualties. An indiscriminate weapon is one that cannot be controlled, through design or function. Some weapons are considered indiscriminate because, although they can be directed at a military objective, they may have otherwise uncontrollable effects that cause disproportionate civilian injuries or damage. Biological weapons are an example.

A4.8. Biological and Chemical Weapons.

A4.8.1. Biological Weapons. International law prohibits the use of biological weapons or methods of warfare. These weapons are also prohibited by the 1972 *Convention of the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction.* The US, along with many other states, is party to this treaty.

A4.8.2. Chemical Weapons. The 1993 *Convention on the Prohibition of the Development, Production, Stockpiling, and Use of Chemical Weapons And on Their Destruction (Chemical Weapons Convention),* entered into force on 29 April 1997 and bans the use of chemical weapons as a method of warfare. The *Chemical Weapons Convention* corrects a shortfall in the 1925 *Geneva Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases and of Bacteriological Methods of Warfare*, which prohibits the use of chemical weapons in combat, but not their development, production, stockpiling or transfer.

A4.8.3. Herbicides and Riot Control Agents. US policy on herbicides and riot control agents in war is set forth in an Executive Order: The United States renounces, as a matter of national policy, first use of herbicides in war except use, under regulations applicable to their domestic use, for control of vegetation within US bases and installations or around their immediate defensive perimeters and first use of riot control agents in war except in defensive military modes to save lives, such as:

- Use of riot control agents in riot situations in areas under direct and distinct US military control, to include controlling rioting prisoners of war.
- Use of riot control agents in situations in which civilians are used to mask or screen attacks and civilian casualties can be reduced or avoided.
- Use of riot control agents in rescue missions in remotely isolated areas, of downed aircrews and passengers, and escaping prisoners.
- Use of riot control agents in rear echelon areas outside the zone of immediate combat to protect convoys from civil disturbances, terrorists, and paramilitary organizations. The Secretary of Defense shall take all necessary measures to ensure that the use of riot control agents and chemical herbicides in war by US Armed Forces is prohibited unless such use has Presidential approval in advance. Executive Order Number 11850, 8 April 1975. The *Chemical Weapons Convention* bans the use of riot control agents as a method of warfare. However, the use of riot control agents permitted under Executive Order 11850 has been deemed consistent with the *Chemical Weapons Convention* since the listed uses are not considered 'as a method of warfare.'

A4.8.4. Poison. Article 23(a) of the Hague Regulations forbids states to employ poison or poisoned weapons. The prohibition against poison is based on its uncontrolled character, on the fact that it is inevitably disabling or fatal, and on the traditional belief that it is treacherous to use poison.

A4.9. Nuclear Weapons. The US does not regard the use of explosive nuclear weapons, whether by air, sea, or land forces, as a violation of existing international law. Nuclear weapons can be directed against military objectives as can conventional weapons. However, the authority of United States forces to employ nuclear weapons resides solely with the President. Moreover, the United States is a party to numerous treaties that regulate the use of nuclear devices. Some examples are the Additional Protocol II to the Treaty for the Prohibition of Nuclear Weapons in Latin America, the Outer Space Treaty, and a treaty prohibiting nuclear weapons on the seabed.

A4.10. Conventional Weapons and Weapons Systems.

A4.10.1. Aircraft, Rockets, and Guided Missiles. The use of aircraft, rockets, and guided missiles by land, sea, or air forces against combatants and other lawful military objectives is clearly permissible.

A4.10.2. Fragmentation Weapons. The use of explosives and fragmentation particles, such as those contained in projectiles, mines, bombs, rockets, missiles, and hand grenades, is not prohibited under the law of armed conflict. Cluster bomb units, a more recent development in warfare, are only a refinement or special type of fragmentation munition.

A4.10.3. Incendiary Weapons. Incendiary weapons, such as incendiary ammunition, flame throwers, napalm, and other incendiary agents, have widespread uses in armed conflict. They are clearly regarded as lawful in situations requiring their use. Any controversy over their use arises from a concern for the medical problem in treating burn injuries and from arbitrary attempts to analogize their use to the use of prohibited means of chemical warfare. The potential danger of spreading fire has also raised concerns about civilian protection. Their use should be avoided in urban areas, to the extent that other weapons are available and are equally effective.

A4.10.4. Delayed Action Weapons. Air-dropped mines and other delayed action weapons are legal. However, mines are unlawfully used when they are attached as booby traps to any object that is protected under international law, such as to wounded and sick personnel, dead bodies, or medical facilities. Also objectionable are portable booby traps, such as fountain pens, watches, and trinkets, that would expose any civilians who might be attracted to the object, to an injury. Mines must not be used to prevent the rescue of wounded and sick persons, or to deny civilians protection. Under the Hague Convention VIII, there are specific treaty restrictions on the use of mines in sea warfare.

Attachment 5

TARGET ANALYSIS

A5.1. Introduction. Target analysis is extremely important when making recommendations regarding which targets should be attacked to fulfill a commander's objectives. This attachment examines several methods of determining relative worth or value of targets. Types of rankings, and methodologies used in the USAF Nonnuclear Consumables Annual Analysis (NCAA), nuclear targeting, and the determination of priorities are included. This attachment also examines several types of analysis, along with illustrative examples.

A5.2. Types of Ranking.

A5.2.1. Ordinal Scale. One of the easiest methods of ranking target value involves the use of ordinal scales to assign factors a priority according to their relative worth. Target A may be more important or valuable than Target B but less valuable than Target C. It would be logical to infer that Target C is also more valuable than Target B. However, their absolute relationship remains unknown under this approach. Using this method, we may know that Target A is more important than Target B, but we do not know how much more important.

A5.2.2. Metric Scales. A second method of ranking targets would be to use metric or cardinal scales to determine their worth in some "real" sense. In a simple case, we can rank people by their ages. Joe might be 25 years old and Sam 37 years old. We can rank these individuals not only relatively but also absolutely. Relatively, Sam is older than Joe; absolutely, Sam is 12 years older than Joe. Thus, metric scales can apply to targets. For example, one airfield's runway is 2,000 feet longer than another's; one airfield has 25 more assigned aircraft than another. This method of ranking is most desirable but the most difficult, because there is rarely any single measure of their comparative value. A combination of measurements must be used. Usually the ways these factors are measured does not directly reveal their threat to friendly forces or value to the enemy.

A5.2.3. Ratios. Another method is to develop a ratio of relative worth by determining, for example, that Target D is twice as important as Target E, and four times as important as Target F. However, this method does not measure each individual target's absolute value. Often a value of 1 is assigned to some baseline target, and all other targets are assigned values with respect to the baseline. The USAF Nonnuclear Consumables Annual Analysis (NCAA) uses this type of ranking, which recognizes that the relative value of targets can change over time during a conflict. This methodology divides the period of action into three phases: the initial or intense phase, covering the first 10 days of action; the transition phase, covering the next 20 days; and the sustained, or steady state phase, covering the remainder of the conflict. Target values for this type of ranking are determined by combining the independent assessments of several analysts. The final target value set is the weighted geometric mean of the values submitted. The baseline target in this methodology is a tank platoon, which is assigned an arbitrary value of one. Values for other targets are computed to determine their relative importance compared to the tank platoon, for the initial, transition, and sustained phases of the conflict. Some representative target values for the three phases are shown in**Table A5.1.**.

Table A5.1. Representative Target Values.

Target	Initial Phase	Transition Phase	Sustained Phase
Air Defense Control Center	15.0	8.0	7.0
Mobile SAM	15.0	17.0	16.0
Tank Column (10 tanks)	12.0	20.0	15.0
Tank Platoon (3 tanks)	1.0	1.0	1.0
Military Headquarters	0.3	0.3	1.0
Airfield Runway/Taxiway	19.0	12.0	10.0
EW/GCI Radar Site	14.0	16.0	15.0
Mobile SSM	10.0	18.0	13.0
Ammunition/Weapons Plant	0.1	0.2	20.0

A5.2.4. The "Split 100" Method. Another method of ranking, often called the "split 100" method, is to use total points. For example, we might assign a total set of points, adding up to 100, for distribution among a set of targets. We might then divide the 100 points among all the targets, giving Target A so many, Target B some, and so on, and rank them on an arbitrary scale. However, we still do not know any given target's absolute values.

A5.2.5. Aggregation Ranking. Targets can also be ranked by an aggregation of their specific characteristics. Does an airfield have an active air order of battle? What level of activity is apparent? Has the enemy sought to repair damage inflicted on the target? How concentrated have his efforts been? Is the target heavily defended? Are some of its elements hardened to protect them against attack? The answer to each of these questions is relative to the issue of relative target worth. Taken together, these factors can reveal important information that can lead to target ranking. Several statistical techniques may be used to combine these factors into measures of relative utility. The combination of measurement methods will be treated in the remainder of this section.

A5.3. Qualitative Analysis. Because the decision making process is constrained by time, costs, previous experiences, and perceptions of the participants, much decision making in the target development arena is based on qualitative rather than quantitative analysis. Since analysis occurs in an environment where power relationships, personal desires, and the necessity for coordination exist, problems can almost never be approached on a completely systematic basis. Many decisions are somewhat arbitrary, in that critical choices have already been made in selecting the alternatives. Much of targeting is concerned with value choices that can be explicitly described in words but are extremely difficult to express in the languages of mathematics or the computer.

A5.3.1. However, qualitative analysis is not a substitute for quantitative analysis. Both are useful and complementary techniques for structuring a problem to reach a rational conclusion. Both may be used to reduce uncertainty in decision making. Each technique has strengths that tend to diminish the limitations of the other.

A5.3.2. In targeting, qualitative analysis is the examination of potential targets to determine importance, significance, and priority of attack based upon value choices which are not quantifiable. Qualitative analysis is often necessary when precise information on quantities is unavailable. For example, the quantities of supplies reaching the enemy forces at the forward area has shown historic significance in the outcome of battles. Unfortunately, this effect is extremely difficult to quantify.

A5.4. Quantitative Analysis. In its present form, quantitative analysis appears under various labels: operations research, systems analysis, management science, policy analysis, computer analysis, weaponeering, or any one of a number of others. These labels have in common the use of mathematical models to aid in problem solving.

A5.4.1. Since targeting decisions vary in complexity, quantitative analysis can be used in various ways. The numbers of people and organizational units affected, the degree of structural change required, and the costs of such changes are factors that determine the scope of a given decision situation.

A5.4.2. The targeting decision maker has many quantitative models to choose from. These models tend to be either macrosystems or microsystems. Macrosystem analysis approaches a problem from an extensive point of view. It attempts to consider all of the variables that could contribute to, or extract value from, the proposed alternatives. For example, it might weigh the technical, political, economic, social, and aesthetic considerations that would lead to success in a given battle. Macroanalysis tends to take place at the higher levels of the DoD hierarchy where decisions concern broad allocation of resources, planning for major campaigns, and overall review of ongoing operations. At these levels, decision makers are not necessarily interested in the implications and overall impact of the specific situation. Microsystems analysis, on the other hand, approaches a problem from an intensive point of view, concentrating on a single variable, such as the cost of destroying a particular target. This approach leaves the consideration of remaining variables such as how to win the battle to other efforts. At lower levels, applications lean toward a micro approach, where decisions are made to ensure specific tasks are carried out effectively and efficiently.

A5.4.2.1. The use of models and quantitative analysis techniques in targeting offers many advantages. They allow planners to handle problems that are both large and complicated, allowing consideration of only the most relevant factors. They provide a risk-free, low-cost environment to test tactics and strategy before implementation.. Alternative courses of action can be recommended to the commander accompanied by impact analysis. Finally, the use of models makes it necessary to define the facts for a given problem and forces the decision making participants to state their feelings, objectives, values, and assumptions explicitly.

A5.4.3. Examples of Quantitative Analysis.

A5.4.3.1. Simple Target Methodology . Most of these applications have been oriented toward examination of selected components of target systems. In the case of an aircraft delivery system, the weaponeering model attempts to grasp the physical characteristics of the aircraft as it moves through air space, the weapons as they strike the target and the resulting interaction of the weapons effects on the target structure. The weaponeering model of this problem considers a large number of details, ranging from the position of the aircraft in space to the geometry of the bombs hitting the ground. However, the model involves only one aircraft and one target. The situation and the scope of the models also limited by the assumption that the aircraft successfully reaches and acquires the target. **Table A5.2.** shows a sample set of inputs and outputs for a typical non-nuclear weaponeering problem.

Table A5.2. Input and Output Weaponeering Sample.

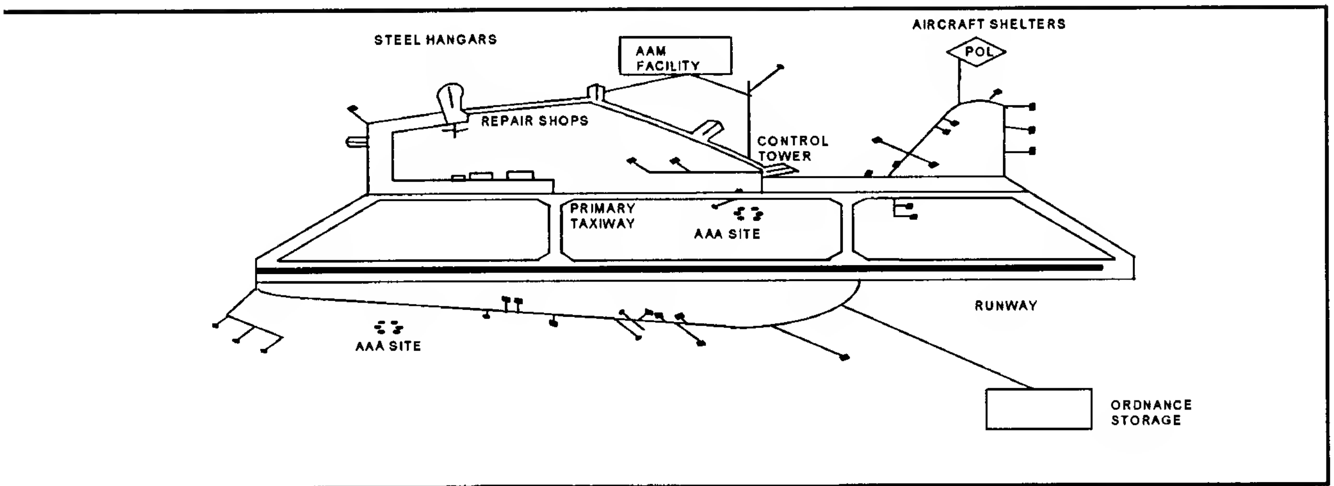
Variables	Inputs Values
# of Acft	7
Impact Angle for Bomb	57 degrees
Circular Error Probable (CEP)	40 mils
Altitude of Release of First Bomb	7000'
Slant Range	8000'
Length of Stick	250'
Width of Stick	40'
Length of Area	1000'
Width of Area	1000'
Ballistic Dispersion	5 mils
Bomb Reliability	0.95
# of Weapons Released per Pulse	1
Number of Pulses	3
	Outputs
Fractional Damage Expected from One Pass	2030
Damage Expected from All Seven Passes	7970

A5.4.3.2. Complex Target Methodology. This method expands the scope of models to include complex targets with multiple parts. For example, a model might determine the probabilities of damage to several of the components of a large airfield complex.

A5.4.3.2.1. A typical approach using traditional weaponeering concepts would be to compute the probabilities of inflicting various types of damage on each of the components of the airfield separately. Thus, the runway would be weaponeered with a given number of aimpoints, while the hangarettes might be considered separately, as a single area (or set of area targets), and POL, storage areas, and support buildings would each be weaponeered separately.

A5.4.3.2.2. Another approach would be to treat the entire airfield as a single complex target. The separate components would be defined in the context of the larger model which considers all of the parts and their relationships to each other. A sample airfield with such geographic interrelationships is shown in figure A5.1.

Figure A5.1. Illustrative Airfield. The entire airfield is a single complex target, with separate components defined in the context of the entire complex. Thus, all parts and their relationships may be explicitly determined.



A5.4.3.2.3. After the airfield has been described, with appropriate structural descriptions and distance measurements, it is then possible to evaluate potential collateral damage on components near the selected target. For example, when the target is an aircraft shelter, the probability of cratering the taxiway would be evaluated. The problem of collateral damage can be computed with point or area targets, if either guided or unguided weapons are used. This complex model can be used to compute damage to targets offset from the aiming point and to determine damage probability for the target at the aiming point and any other target in close proximity. This approach makes it possible to evaluate all targets and their structural characteristics and sizes. The problem can also be solved using more complex methodologies based on simulation techniques.

A5.4.4. Target Utility Analysis. Target utility systems can be applied to problems of varying scope, ranging from large scale problems (strategic planning applied to an entire country) to small scale situations. In this analysis technique, the utility or usefulness of different targets is weighed against the cost of attacking the target. Those targets with the highest pay-off at lowest losses are then prioritized. The following paragraphs is an example of how to use a subjectively derived weighing scheme to evaluate an attack against a complex installation such as an airfield.

A5.4.4.1. The concept of attacking enemy airfields is an integral part of counterair operations. However, its value depends largely on two factors: analysis of results to be achieved versus losses to be incurred, and the trade-off between the use of air assets for airfield attack as opposed to other missions.

A5.4.4.2. A number of factors must be considered in targeting airfields--formidable air defenses; sheltering of aircraft; hardened command and support facilities; dispersed target elements at the main field and dispersal or forward operating bases which are equipped well enough to support air operations in the event the main operating bases are attacked.

A5.4.4.3. When attacking an airfield, a number of potential results may be sought. For example, if the commander wants to ensure aircraft at the airfield are destroyed, all effort may be directed against the aircraft themselves. However, because other aircraft can readily be moved into the airfield complex, it may also be useful to damage the airfield facilities. In this case, attacks would be directed against the runway, the POL, or other collocated facilities to make them unusable.

A5.4.4.4. Options could be arranged into categories. For example, in one case three general objectives could be of interest: the first would involve destroying aircraft; the second, cutting runways; and the third, destroying support areas. Under each of these options, **Table A5.3.** shows the following factors that must be considered:

Table A5.3. Example Options/Factors Case.

Category 1	Category 2	Category 3
Destroy Aircraft	Cut Runway	Destroy Support Area
Aircraft in open or revetments	Short term damage (Minimal cuts)	POL
Aircraft in shelters	Long term damage (Heavy damage to runway)	Ammunition storage
		EW/GCI

A5.4.4.5. The planner can assign these categories relative weights from a total pool of 100 points. For example, all 100 points could be assigned to Category 1 and none to categories 2 and 3 if the interest is only in destroying aircraft and not in closing the runway or destroying the support facilities. To emphasize each category, the 100 points could be distributed as follows: Category 1, 50 points; Category 2, 30 points; Category 3, 20 points. The decision maker must make the final decision as to the best combination of objectives.

A5.4.4.6. The second step is to assign weights within each category. For example, in Category 1 (Destroy Aircraft), the 100 points could be divided with aircraft in open or in revetments, 20 points, and aircraft in shelters, 80 points. This could be because all of the aircraft are equally important regardless of whether they are in the open, in revetments, or in shelters, but 80 percent of them may be in shelters in an attack.

A5.4.4.7. After all discussion and final agreement by the planners and other participants, the final assignment for all factors might be as shown in **Table A5.4.**:

Table A5.4. Example Relative Weight Assignment.

Category 1 (50 points)	Category 2 (30 points)	Category 3 (20 points)
Destroy Aircraft	Cut Runway	Destroy Support Area
Aircraft in open (20 points)	Short term close (70 points)	POL (30 points)
Aircraft in shelters (80 points)	Long term close (30 points)	Ammunition storage (30 points)
		EW/GCI (40 points)

A5.4.4.8. Under this scoring system, the factors of destroying aircraft and closing the runway have more weight than destroying support facilities unless they are adjusted. To adjust these factors, multiply the points assigned to each individual factor by a "fractional bias" factor for the component (figure A5.2). Here the fractional bias factor (represented by "f" in the following calculations) is the number of factors in the category, divided by the total number of factors listed.

Figure A5.2. Fractional Bias Factor.

$$(\text{Category 1}) = \frac{\text{number of factors in Category 1}}{\text{number of factors in all categories}}$$

f (Category 1) = 2/7
f (Category 2) = 2/7
f (Category 3) = 3/7

These factors are then used to weigh the assigned values for each factor as shown below:

Category 1	Category 2	Category 3
Destroy Aircraft	Cut Runway	Destroy Supplies
Aircraft in open (20 x 2/7 = 5.71)	Short term (70 x 2/7 = 20)	POL (30 x 3/7 = 12.86)
Aircraft in shelters (80 x 2/7 = 22.86)	Long term (30 x 2/7 = 8.57)	Ammunition (30 x 3/7 = 12.86)

	EW/GCI (40 x 3/7 = 17.14)

A5.4.4.9. The final weights for the factors would then be determined as illustrated in figure A5.3. The weighted factors can then be multiplied with computed probabilities of damage (PD) into munitions effectiveness values that show the relative value of attacking each target. This number can be used in weaponeering as a means to optimize target selection for the most valuable output by comparing the potential value of an attack on each component.

Figure A5.3. Airfield Attack Options: Adjusted Scoring System.

F1 = Aircraft in open = 5.71 x 50 = 285.5

F2 = Aircraft in shelters = 22.86 x 50 = 1143.0

F3 = Close Runway (Short term) = 20 x 30 = 600

F4 = Close Runway (Long term) = 8.57 x 30 = 257.1

F5 = Destroy POL = 12.86 x 20 = 257.2

F6 = Destroy Ammunition = 12.86 x 20 = 257 .2

F7 = Destroy EW/GCI = 17.14 x 20 = 342.8

Finally, these weighted factors can be combined with probabilities of damage based on standard weaponeering calculations into a single measure of effectiveness (EM) as follows:

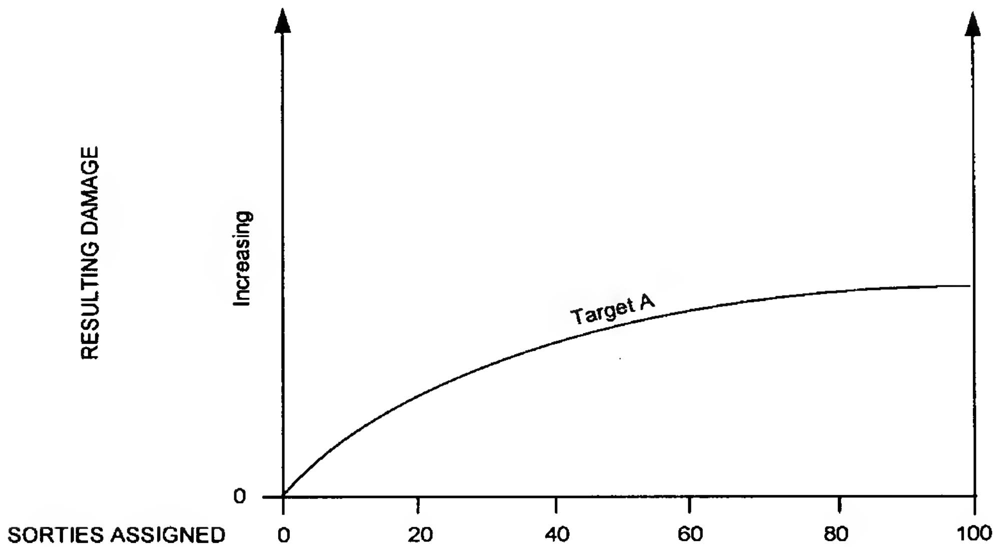
$$EM = F_1 \text{ x } Pd_1 + F_2 \text{ x } Pd_2 + F_3 \text{ x } Pd_3 + F_4 \text{ x } Pd_4 + F_5 \text{ x } Pd_5 + F_6 \text{ x } Pd_6 + F_7 \text{ x } Pd_7$$

A5.4.5. Expected Value Model. This example describes the use of a mathematical model developed around the concept of "expected value." Targets are defined in terms of size and relative worth. Weaponeering calculations provide estimates of potential levels of damage coverage or from a single sortie for each target. Targets and their associated factors are then combined into a scheme that lets us compare the impact of striking the target system one way versus another.

A5.4.5.1. In two target cases, for example, it is possible to compute the damage expected to each of the two targets over a range of application levels. Trade-offs can then be made between putting ordnance on one target or another. Keeping track of the total damage to be expected while making these tradeoffs allows us to find the optimum approach.

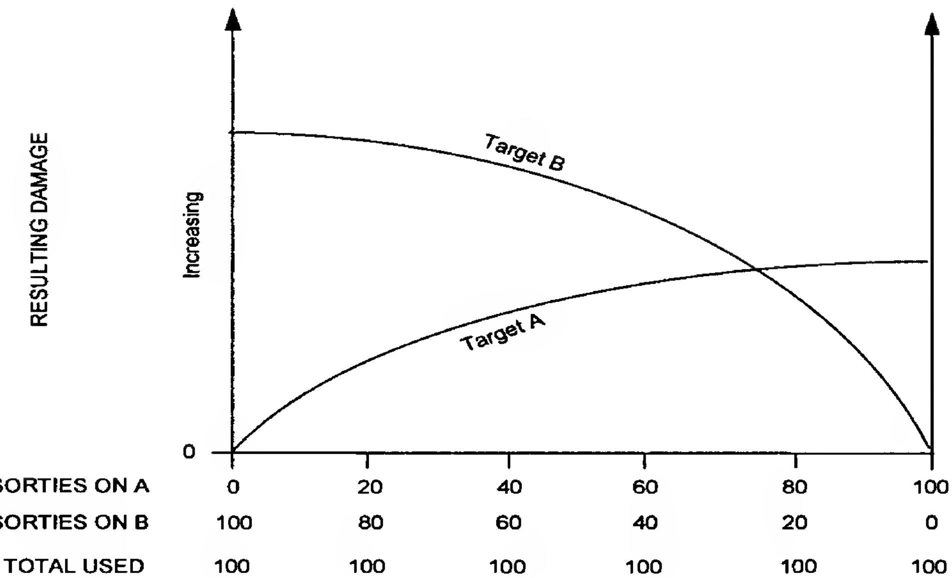
A5.4.5.2. It is possible to compute the expected damage from striking one target with one aircraft, a few aircraft, numerous aircraft, or with all the sorties that are available. The curve in figure A5.4 suggests the effects of striking a given target with varying numbers of sorties. The shape of the curve reveals that the more sorties allocated to damage the target, the harder it is to increase the damage level beyond a given point. The curve represents the classical economic principle of the law of diminishing returns.

Figure A5.4. Sorties Allocated to the Illustrative Target. The shape of the curve reveals that the more sorties allocated to the target, the harder it gets to increase the damage level.



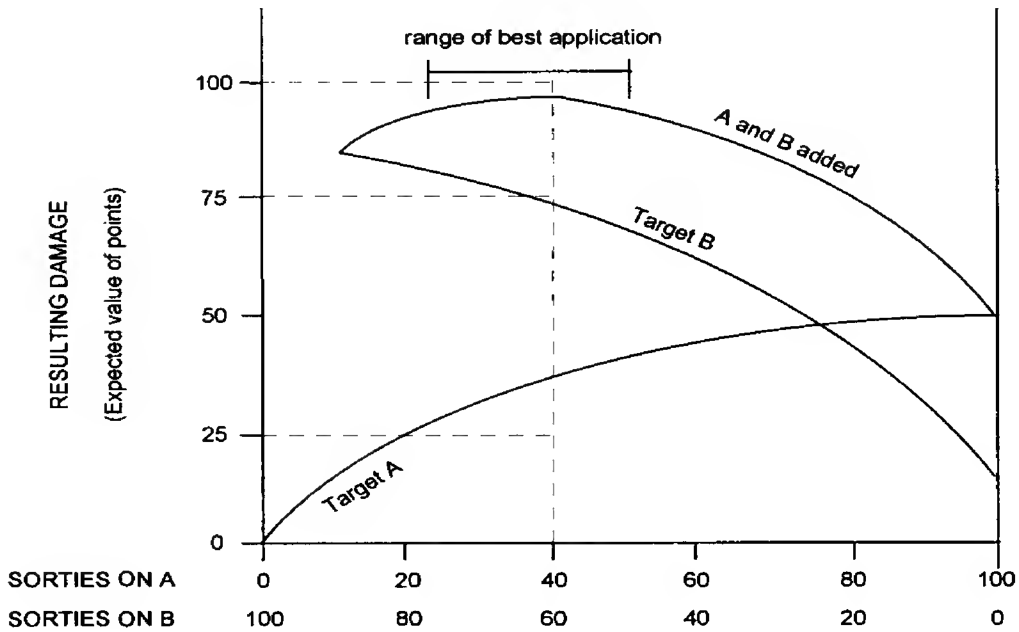
A5.4.5.3. Further defining the sample problem, assume that 100 aircraft sorties are available to allocate against two targets. They could all be assigned against the first target, all of them against the second target, or assigned between both targets. The diminishing return curves for both targets could be plotted on the same graph, constructing one from left to right and the other from right to left (figure A5.5). That is, if all sorties are allocated to Target A, then Target B will get none; if Target B gets all the sorties, then Target A will get none; and if Target A gets 20 sorties, then Target B gets 80, and so forth. In its current state, the Y or vertical axis of the graph is dimensionless, representing relative levels of damage rather than absolute levels.

Figure A5.5. Sorties Allocated to Two Illustrative Targets.



A5.4.5.4. Under the concept of expected value, values can be assigned to this axis. The Y axis would represent the total expected value achieved on the target, based on a consideration of the fractional level of damage achieved and on the pre-assigned values. If the total expected values for both targets at any given point on the graph are added, a new curve as shown in figure A5.6 is produced. For example, if 40 sorties are placed on Target A and 60 sorties are placed on Target B, a total expected value of 100 points (or area killed, etc.) is determined (25 from Target A, and 75 from Target B). The third curve in the graph reveals the optimum point (or indifference range) where optimum damage is achieved. Allocating sorties in a manner indicated outside the range is inefficient. For example, if 80 sorties were placed on Target A, then only 20 would be left for Target B. In this case, the curves reveal that too much effort is allocated to Target A and the resulting overall damage is degraded to 75 units of total expected value.

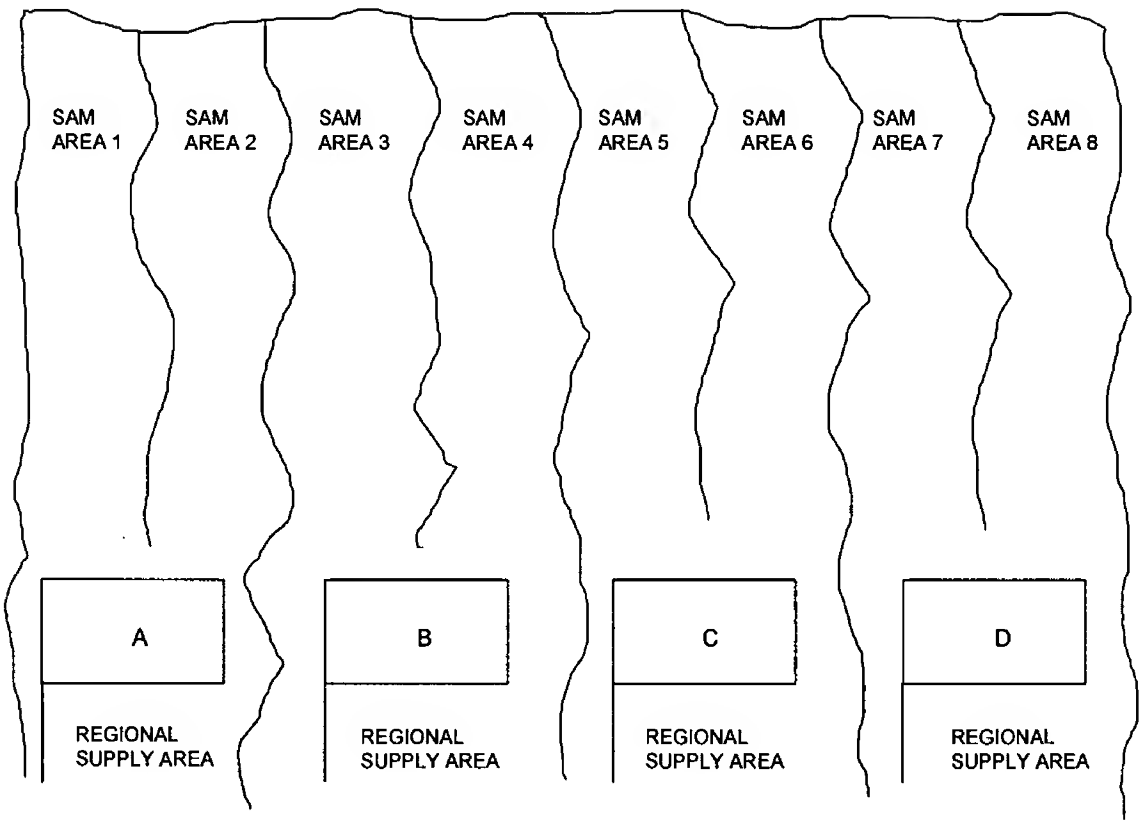
Figure A5.6. Sorties Allocated to Two Illustrative Targets Using a Total Value Curve.



A5.4.6. Linear Programming Analysis. One of the other general tools available to the analyst is linear programming. It has a special value in transportation scenarios as it arises naturally in the context of determining optimal shipping patterns. It is also useful in structuring targeting problems involving systems designed to supply people and material. An example of its application follows.

A5.4.6.1. There are four SAM supply points in a given area. Each supply point has a maximum of 50 missiles that can be used to resupply designated area sites. Each supply point has primary responsibility for two general SAM site areas. The sketch in figure A5.7 shows how these systems might be arranged.

Figure A5.7. Illustrative Example of SAM Supply Points and Site Areas.



A5.4.6.2. It is assumed each supply area is primarily responsible for the two general site areas associated with it, but missiles can be transported to other sites on an emergency basis. It is also assumed under combat operating conditions each area requires ten missiles a day to replace its expended inventory. Because each supply point is set up to provide replacements for its two primary areas, it is less expensive to the enemy to move the missiles from the supply point to the two primary areas than to move them from that point to secondary areas. The farther the area is from the supply point, the more it costs the enemy in terms of time, transportation, equipment, men, and other assets. The assumed costs are indicated in **Table A5.5.**:

Table A5.5. The SAM Supply Problem: Missile Shipping Cost.

Costs of Shipping Missile from Supply Points to Areas of Sites, Based on Time, Labor, Equipment Used, and Other Factors

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8
Supply Area A	10	10	20	20	30	30	40	40
Supply Area B	20	20	10	10	20	20	30	30
Supply Area C	30	30	20	20	10	10	20	20
Supply Area D	40	40	30	30	20	20	10	10

A5.4.6.3. **Table A5.6.** illustrates the distribution breakout, if each area expends ten missiles a day and requires resupply, and if the enemy uses the most efficient method of resupply. Using this distribution, each area would receive the ten missiles needed, and the total costs to the enemy would be 800 cost units (men, material, etc.). These costs can be determined by looking at the above chart and considering costs per unit for the preceding chart. Each missile costs ten units to send to the nearest area. Ten missiles cost 100 units. The total adds up to 800 units.

Table A5.6. The SAM Supply Problem: Possible Distribution of Missiles.

Distribution of Missiles in an Economic Manner

	Area 1
Supply Area A	10
Supply Area B	
Supply Area C	
Supply Area D	

A5.4.6.4. When conducting operations against such a system, the commander is interested in the greatest possible disruption of resupply efforts. If enough attack forces were available, they might eliminate all four supply areas and all of the missile sites. However, when competition is high for the allocation of attack resources, it is not normally possible to perform such a devastating task. Therefore, a planner should examine the relative merits of destroying parts of the system. These merits can be measured in terms of equipment available to the enemy, costs associated with moving the equipment around, or a combination of both approaches.

A5.4.6.5. As an example, if strikes eliminated the first supply area, the enemy would have to resupply from other, undamaged areas. Since the resupply capability of each area is limited, the most economical solution would be as shown in **Table A5.7.**. Because it costs more to send missiles from supply area B to areas 1 and 2 than it did from supply area A, the total minimum cost of the effort to the enemy has been raised to 1000 cost units. Strikes that destroy both supply area A and supply area B make the enemy's resupply costs even higher, as shown in **Table A5.8.**.

Table A5.7. The SAM Supply Problem: Redistribution Resulting from Strikes to One Area.

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	
Supply Area A		(Destroyed)							
Supply Area B		20	20	10	10				
Supply Area C						10	10		
Supply Area D								10	10=100

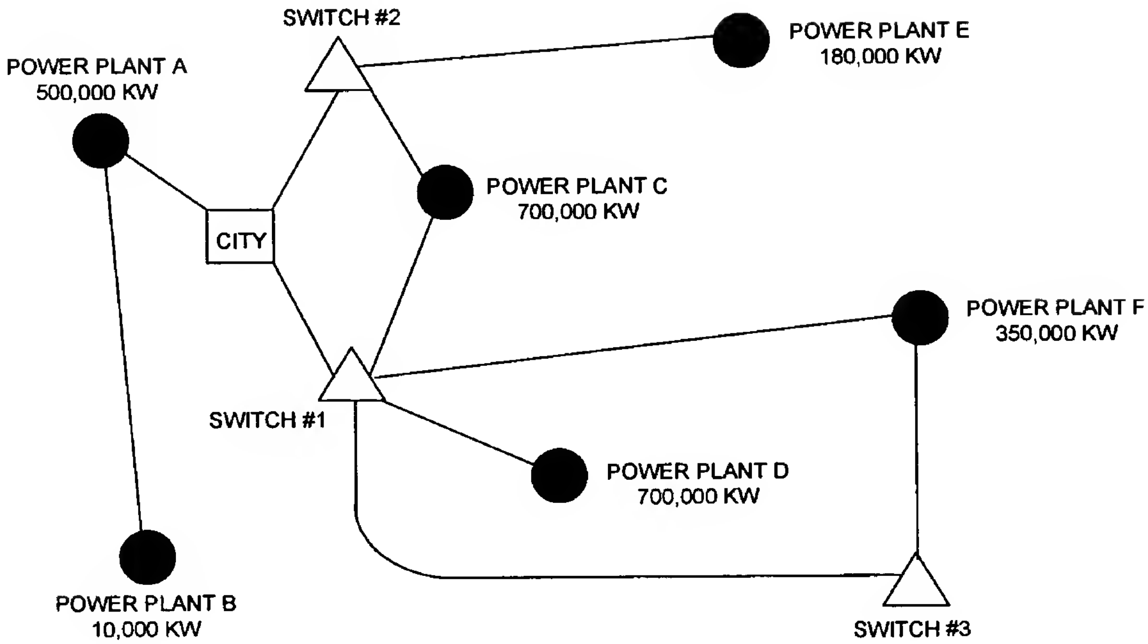
Table A5.8. THE SAM SUPPLY PROBLEM: REDISTRIBUTION RESULTING FROM ADDITIVE STRIKES.

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	
Supply Area A		(Destroyed)							
Supply Area B		(Destroyed) 20		10	10				
Supply Area C	30			20	20	10	10		
Supply Area D			40					10	10=150

A5.4.6.6. This sample application of the transportation problem to a targeting situation is relatively simple. Once the problem is appropriately structured, the relative merits of approaching the target system become more apparent. In the real world of targeting, problems are rarely this simple. However, it is possible to use more elaborate models that include a greater level of detail, such as factors of resupply, exchanges between attacking aircraft and SAM sites, etc. Once the problem is appropriately structured, linear programming techniques already developed for the computer will determine relative solutions and give indications of their merits.

A5.4.7. Network Models in Targeting. The network model is also useful in targeting situations where it can be used to represent systems that have something flowing through them,(i.e., lines of communication, command networks, or power systems.) To illustrate this approach, an example based on a simplified representative power system is used. Figure A5.8 shows a power grid supporting a city and the relationship among power sources, switching stations, and power lines. From this diagram, key points may be identified which, when destroyed, will have the greatest impact on the overall system.

Figure A5.8. Representative City Power System.

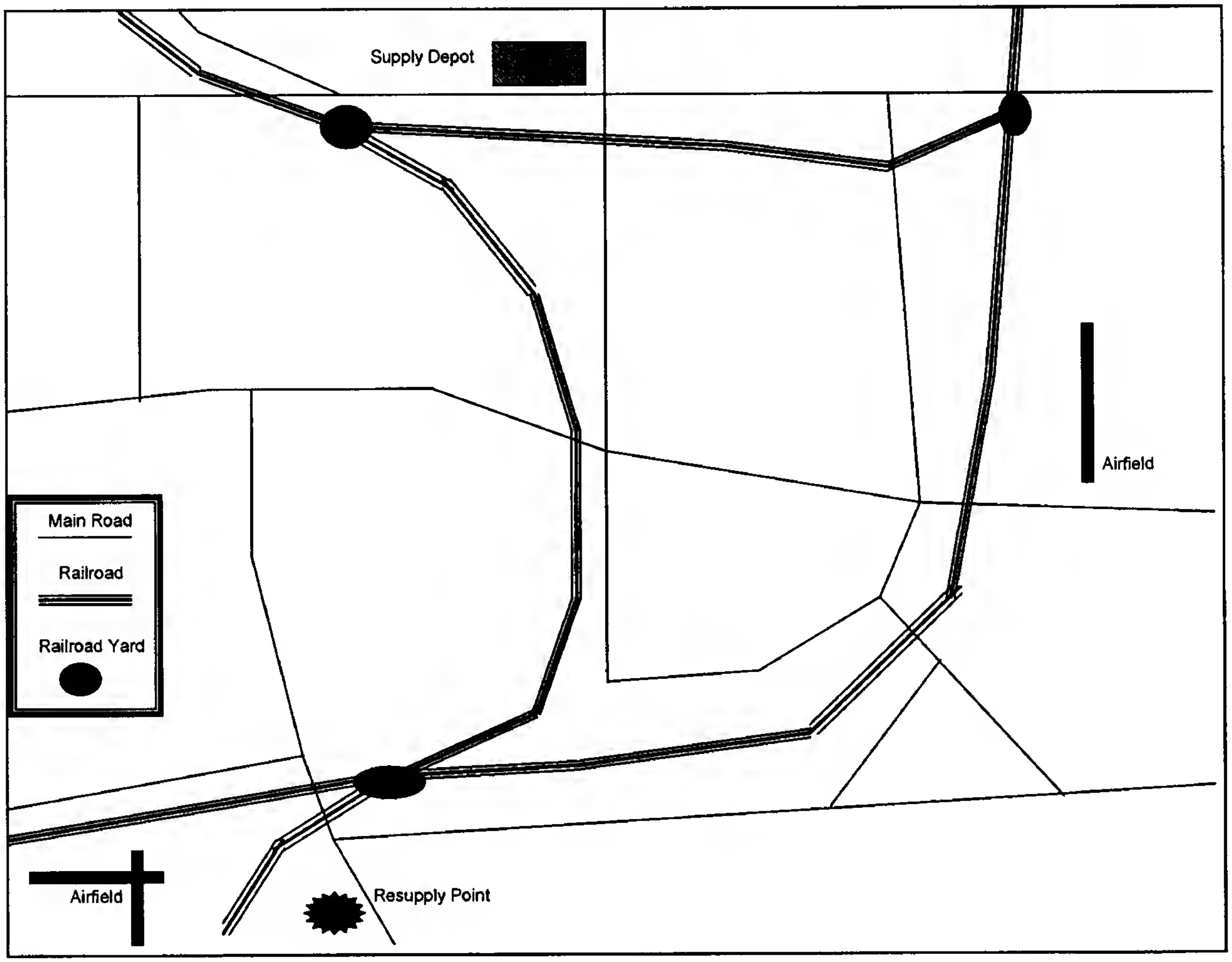


A5.4.7.1. Under the best of conditions, if all of the available power is directed toward the city, disregarding any line loss, a total of 2,440,000 kilowatts (kW) are available. If parts of the system are removed, the resulting effects on the city's power supply can be computed. For example, if Switch #3 were removed there would be no change because the power would simply be rerouted through Switch #1. However, if Switch #1 were removed, 1,050,000 kW, or 43 percent of the total power in the system, would not be available to the city.

A5.4.7.2. Under normal conditions. it could be difficult to remove parts of a system. Weaponeering techniques can compute the probabilities of success and the results would dictate the optimum allocation of available aircraft. All available sorties might be best used against Switch #1, or the sorties might be divided among the various power sources to produce the same effect. Although this example is greatly simplified, full network models can handle the hundreds of variables that comprise elaborate flow systems, and complex computer programs have been developed to handle such models.

A5.4.7.3. Lines of Communication (LOC) Network Mode . Several network models for LOCs are available for examining interdiction problems. Computer models have been developed to evaluate the capability of a transportation network to deliver supplies to destinations while road segments of the network are being successively destroyed and repaired. Initial models took an austere approach defining the logistical network in its simplest form. What roads are there? How are they connected? What is their capability to carry traffic? How many trucks are available? Similar models can be expanded to include additional costs (cost of repair, cost of interdiction, etc.) and other constraints (total repair capability, etc.). They can also account for the cushioning effect of interim supply points. Several criteria can be stated for these models in terms of: maximum cost to the enemy; minimum flow through the system; minimum cost to friendly forces; or any combination of these orientations. A sample LOC network is shown in figure A5.9.

Figure A5.9. LOC Network Example.



A5.4.7.3.1. One difficulty with an LOC network model is that it is a tremendous consumer of data. For example, thousands of road segments must sometimes be described to the computer and then constantly updated. The running of such models is expensive in terms of personnel, machines, and time.

A5.4.7.4. Program Evaluation and Review Technique (PERT). Another useful tool is the specialized version of PERT. PERT was originally developed in 1958 for use in managing the Polaris Fleet Ballistic Missile program. The missile program constituted the desired hardware, while PERT was a software development designed to aid in planning, scheduling, and controlling complex projects. Specific versions of PERT can be used to aid in the analysis of targeting problems. The first step in using it is to construct a network diagram of the problem so that the proper relationship in the situation can be examined (figure A5.10). The PERT terms of reference for this network diagram include:

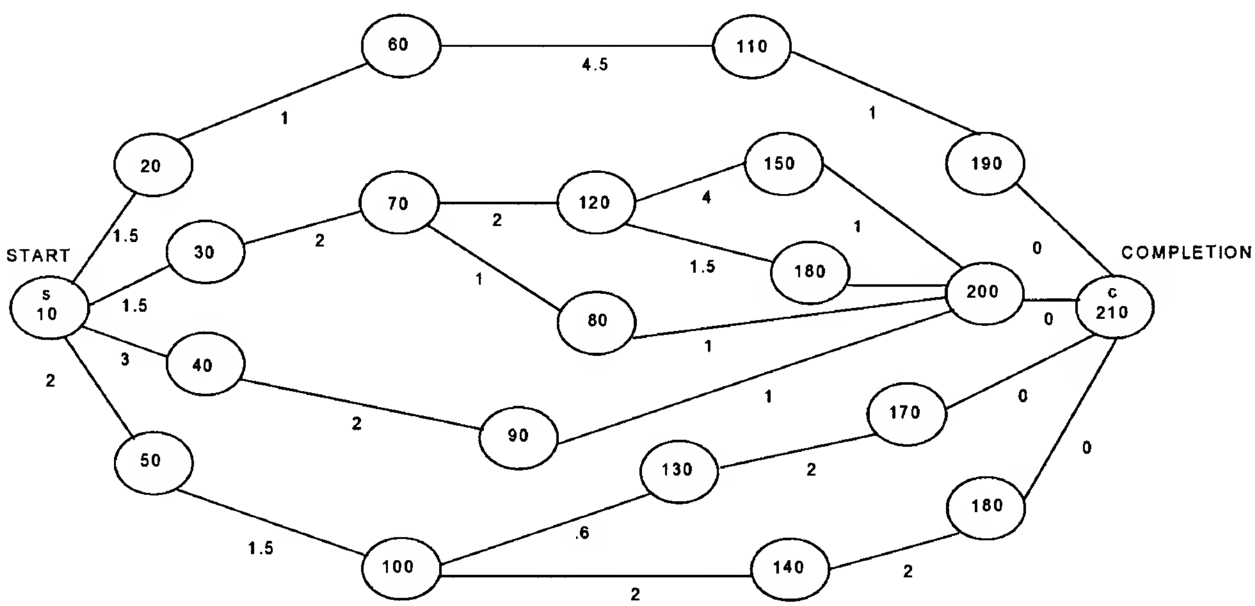
A5.4.7.4.1. Network. It is the pictorial description of the related series of events and activities. All of these must be completed for the enemy to possess a particular capability. For example, producing aircraft requires the ability to manufacture the fuselage, engines, landing gear, and navigation and control systems.

A5.4.7.4.2. Event. An event is an identification of a requirement and does not represent any activity or time consumed. Thus, it can be either the initiation or completion of an activity, in a series of related activities. It is represented by a circle in the pictorial representation.

A5.4.7.4.3. Activity. Lines in the diagram represent the activities involved in moving from one event to another. The lines represent that time is being consumed in the cycle.

A5.4.7.4.4. Critical Path. The sequence of events is indicated by sequential numbering of each circle. The general direction of the arrows is from left to right. Time is expressed above each activity line in hours, days, and so forth. The longest path through the network of events and activities, in terms of time, is designated the critical path. Using PERT, one can determine what the critical path is and target it. This action can lengthen the enemy's time to complete the critical path and result in the delay or prevention of the enemy's completion of a product. Of note, targeting which increases the time of other paths may not delay the product unless it makes one of those paths greater than the critical path. Target analysis should also evaluate the vulnerability as well as the length of paths when determining the most efficient way to reduce enemy system output.

Figure A5.10. Typical Program Evaluation and Review Technique (PERT) Network Diagram.



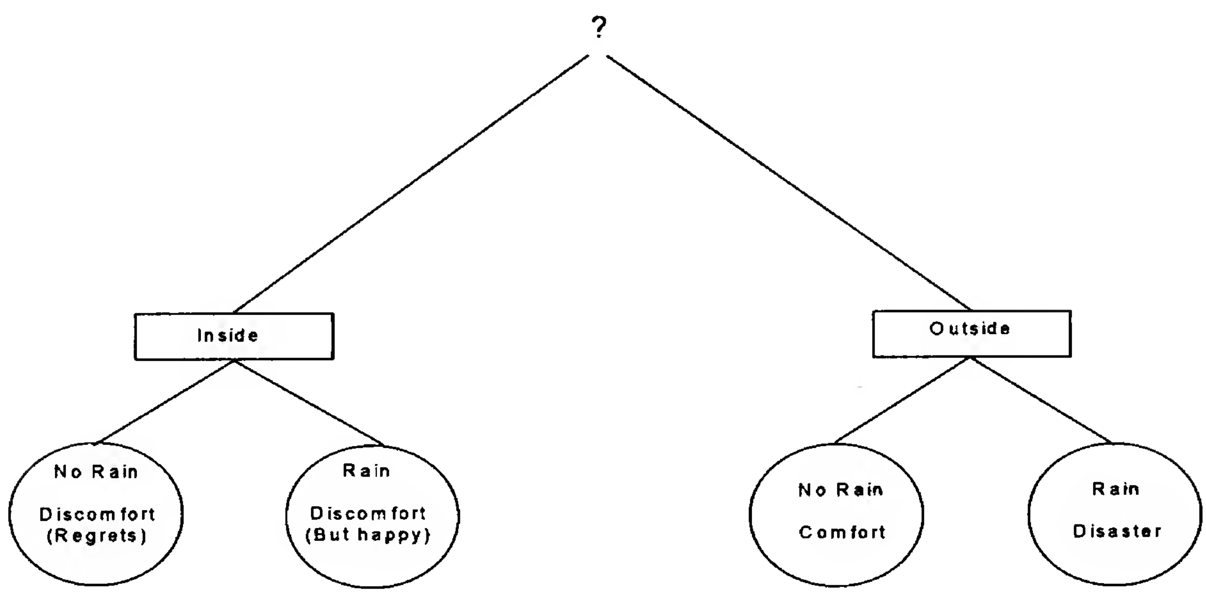
A5.4.8. Decision Tree Approach . This technique is used to display information and represent alternatives, objectives, and the consequences of a series of decisions. The decision tree is an algorithm for the analysis of complex sequential decision problems. It can be used to depict a series of true-false sequences or to depict subjective probabilities and their relationships.

A5.4.8.1. The four-step decision tree technique is straight forward. First, identify the available options and the possible chance events that might occur. Second, draw the tree skeleton. Third, if probabilities are being expressed, enter the economic or statistical data and associated (subjective) probabilities. Finally, analyze the tree to determine the best course of action.

A5.4.8.2. The decision tree terms of reference include decisions, which are normally represented by squares; and change events, represented as circles. The connecting lines are termed branches and depict the alternate courses of action. The trees are normally drawn from left to right but may be drawn from top to bottom for easier presentation.

A5.4.8.3. As an example, consider a patio party. There is a 40 percent chance of rain, and the party cannot be moved once the decision is made. There are only two options: inside or outside. The chance event is rain or no rain. Figure A5.11 illustrates the scenario.

Figure A5.11. Decision Tree.



A5.4.8.4. Next, it is necessary to assess the subjective values of the alternatives in the circles. On an ascending scale, outside - no rain - comfort would rate “4” while outside - rain - disaster would be rate “1”. Finally, it's 60 to 40 against rain. Figure A5.12 illustrates the results of multiplying the subjective value by the value of the chance event. Thus, there is a slight quantified edge (2.8 versus 2.4) for holding the party outside. The use of the decision tree gives the decision maker a simple graphic device, showing the areas where the analyst has been subjective and how that subjectivity affects the recommended course of action.

Figure A5.12. Subjective Values of Alternatives for Decision Tree.

Inside	Outside
No Rain (.6)Rain (.4)	No Rain (.6)Rain (.4)
Discomfort (2) Discomfort (3)	Comfort (4)Disaster (1)
.4 x 3 = 1.2	.4 x 1 = 0.4
.6 x 2 = 1.2	.6 x 4 = 2.4
Inside = 2.4	Outside = 2.8

A5.5. Substitutes for Quantitative Analysis. Because the decision making process can be constrained by time, costs, prior experiences, and perceptions, quantitative analysis is not always used. Since analysis occurs in an environment where power relationships, personal desires and the necessity for coordination exists, problems almost never can be approached exhaustively or on a completely systematic basis. Some alternatives to quantitative analysis follow.

A5.5.1. Intuition . There are two general approaches to this method of decision making. The first involves analytic reasoning by using logical models. Analytic reasoning reduces problems to a base of underlying causal relation. A logical model structured with an explicit set of axioms, premises, and assumptions is set forth, and all effort is directed toward detection of relationships. The decision variables are manipulated in such a manner that some "optimal" equilibrium is reached to form the basis for a decision. The model produced is explicit and well defined, and its behavior can be deduced as logical consequences of its premises. Different people analyzing the same question should arrive at the same answer on the basis of logic alone.

A5.5.1.1. The second approach is a method of heuristic (trial and error) reasoning, using intuitive models and emphasizing workable solutions to total problem situations. The intuitive models may not have well-defined boundaries and are frequently not internally consistent. They are not derived from logic but are based on common sense, intuition, and unquantifiable feelings, making it difficult to determine the mechanisms at work. The heuristic analyst typically shifts thought patterns from one aspect of the situation to another, using loose definitions and bringing various parts of their knowledge to bear.

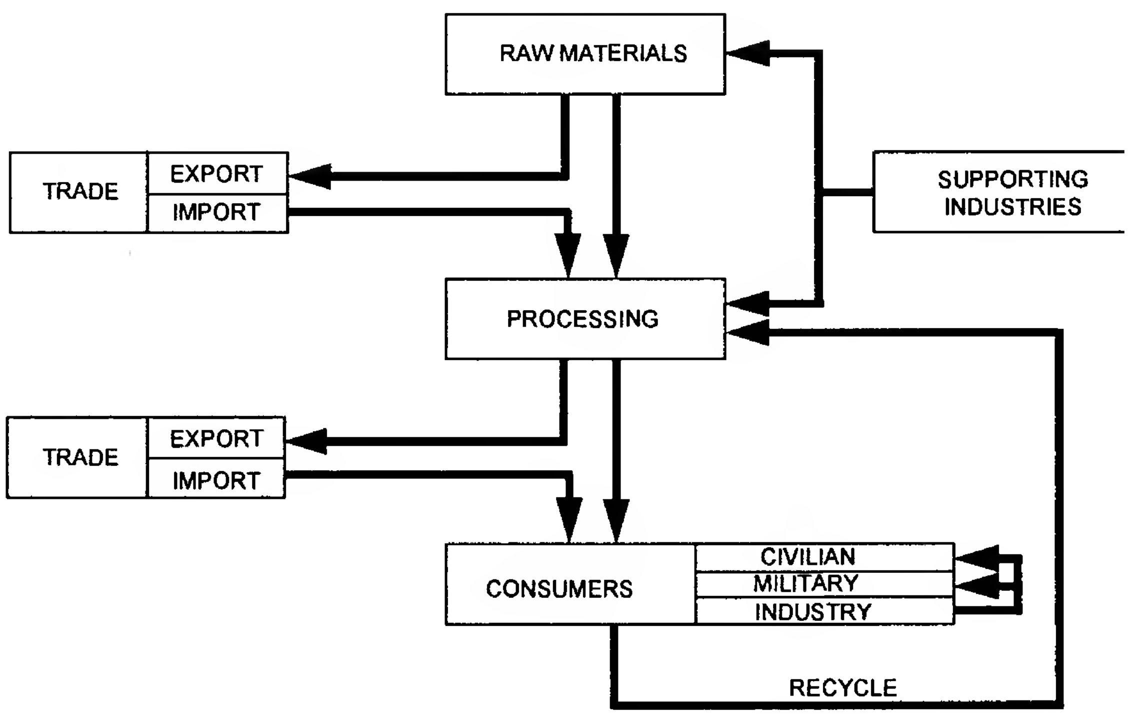
A5.5.2. Influence . Influence in the form of orders, advice, appeal to authority, or expertise, can come to the decision maker from several directions and can often replace analysis in decision making. An analyst may receive direction from a higher echelon or lateral pressure from personnel at equal levels which will significantly affect the decision. Also, subordinates often make suggestions, recommendations, and comments that also influence the decision.

A5.5.3. Experience and Expertise . Often the analyst will ask the experts on the staff for advice on a given targeting problem, and their advice can supplant a significant amount of analysis. When the decision situation resembles a previous situation, this experience often helps to replace some of the analysis the decision situation deserves.

A5.5.4. Habit . Experience can become a habit through repetitive responses. Habit has been called the most general and pervasive of all techniques for making decisions. The collective memories of members of an organization are vast encyclopedias of factual knowledge, habitual skills, and operating procedures. These habits are in part provided by the organization, and in part brought in by new personnel who learned them in educational institutions or on previous jobs. Habits become standard operating procedures when they are accepted and internalized in the organization through formal written, and recorded programs.

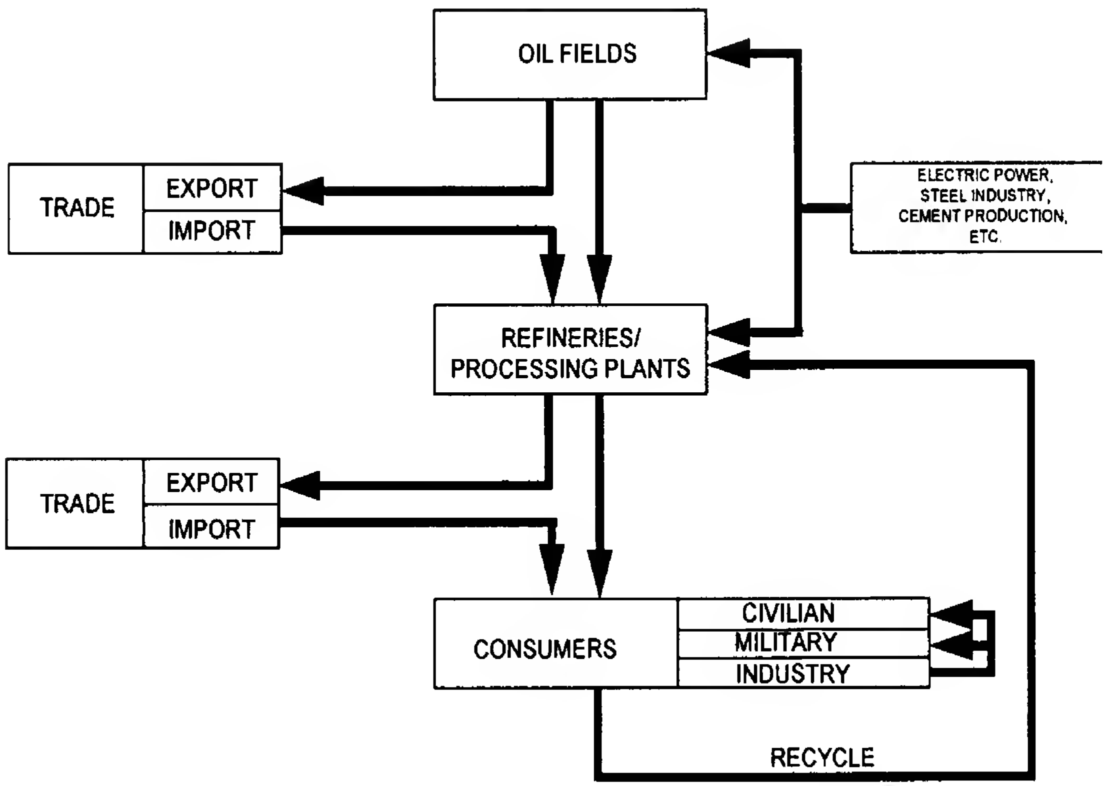
A5.6. "Target System Flow Charting" Analysis. In identifying target system components, specifying the activities of each component, and preparing an analysis model (steps two and three of target development), flow charting is a useful technique. An elaborate computer-based model is not always needed. A simplified model is often adequate. For example, the simplified basic industrial model shown here (figure A5.13.) shows how the basic industrial model may be applied to a nation's petroleum industry (figure A5.14.).

Figure A5.13. Figure A5.13. The Basic Industrial Model.



A5.6.1. The generalized component of the petroleum industry models are identified by the Functional Classification Coding System which identified nine broad groups of targets and their subgroups. Specific installations can then be identified and manipulated using computers. Flow charting is extremely useful in finding where a system and its components are vulnerable. A flow chart may be used to represent components and their relationships at very general levels, or at a single installation. Imagery interpretation manuals are an excellent source of information for flow charting. Another form of flow charting which is useful for time-sensitive targeting is critical time analysis.

Figure A5.14. The Petroleum Industrial Model. The interconnecting lines represent transport or storage in this simplified representation of the petroleum industry.



A5.7. Critical Time Analysis. Critical time parameters are time-sensitive tasks that an enemy must complete effectively and efficiently to achieve its objectives. This analytical method is used to identify those time parameters and the task objectives, and to support target selection. For example, analysis might show that the critical time for an infantry unit is the 18-hour period immediately prior to launching an attack. The enemy's command and control system during that time may include vulnerable communications links between commanders and their units. These communications channels contain directives and information that must be processed in the critical time. The pattern of signals could also indicate a unit's state of readiness for an attack. By targeting these communications channels for destruction or disruption during the critical time, command and control could be degraded, thereby reducing the enemy's effectiveness.

Attachment 6

NONNUCLEAR AND NUCLEAR DAMAGE MECHANISMS

A6.1. Nonnuclear Damage Mechanisms. Knowing the damage each type of weapon can produce is as important as knowing the damage to which targets are susceptible. The nature of the damage a weapon can produce (its damage mechanism) must be correlated to specific target vulnerabilities, or the result may be nothing more than noise, flashes of fire, or holes in the ground. A modern conventional munition is generally composed of a fuze, an explosive filler, and an aerodynamically shaped casing or body, which is strong enough to contain the components during delivery.

A6.1.1. Damage mechanisms are optimized by appropriate fuzing and delivery systems. Some mechanisms are so specialized that they are useless against certain types of targets. For example, despite all of its reassuring dust, blast alone does less damage to many targets than military purposes require. Fragmentation, penetration, and fire also have limitations that can reduce weapon effectiveness when improperly applied. Proper weapon selection must reflect damage mechanism capabilities and limitations for each weapon in the munitions delivery.

A6.1.2. Four basic damage mechanisms are produced by nonnuclear weapons--blast, fragmentation, penetration, and flame or incendiary effects.

A6.1.2.1. Blast. One of the most familiar damage mechanisms is blast, which is the result of two factors acting on structures. The first, peak pressure, is a measure of the maximum force exerted against an object by a blast wave and equals the amount of pressure exerted multiplied by the area over which it acts. To cause damage, blast must be large enough to overcome the structural strength of an object and deform it. The second factor is the duration of the pressure. The force must act long enough to overcome inertia and deform the object sufficiently to cause the required damage. Impulse is a measure of the combined pressure and duration of the blast. Thus, the peak pressure must exceed a minimum value, and the duration of the pressure must be of sufficient length to cause damage by blast.

The minimum values of peak pressure and impulse depend upon the structure type of the target. For example, to collapse a 15-inch thick brick wall generally requires a peak pressure of 3 to 4 pounds per square inch for at least 100 to 120 milliseconds. The pressure required is low because a brick wall is structurally weak under the action of a lateral force. On the other hand, the impulse (time) required is relatively high because of the considerable inertia of a brick wall.

Factors such as the structural strength of an object, its resilience (ability to deform and return to its original state), its size, and its orientation with respect to bomb detonation all influence blast effects on a structure. Blast must be concentrated and accurately positioned against vital elements to produce significant damage.

A6.1.3. Fragmentation. When a charge of high explosive detonates inside a closed metal container, such as a bomb, the container usually breaks into fragments. These fragments are hurled outwards at high velocities and become projectiles that can, depending on their size, velocity, and distribution, greatly damage nearby objects. Combining fragmentation with blast improves effectiveness against most targets.

A6.1.3.1. Obviously, when fragments of jagged steel penetrate an object at an extremely high velocity, they can cause damage that shock waves from an open air blast could not. There are, however, limits to their effectiveness. Most of the fragments spread out in a side spray. The amount of damage from fragmentation depends on the orientation of a munition, as well as its distance from the target when it detonates. The ground burst of a bomb that strikes almost parallel to the surface may cause only a small part of the damage the munition is capable of because many of the fragments impact directly into the ground or are dispersed into the open air.

A6.1.3.2. Lethality depends greatly on how fast the fragments strike the target. At the instant a munition bursts, their speed may be seven times the speed of sound, but they slow as they travel through the air. Small fragments may slow to subsonic speeds in less than a hundred feet; larger ones travel twice as far before becoming subsonic. Generally, fragments are considered damaging only when they are traveling faster than the speed of sound.

A6.1.3.3. The size and shape of fragments can be controlled by changing such factors as the type of explosive and the charge-to-weight ratio of the munition. Mechanical control of fragment numbers, size, and shape can be achieved by grooving or notching the munitions case or by using other methods of predetermining case breakup.

A6.1.4. Penetration. Some targets may be damaged or destroyed by penetration. The ability of a projectile to destroy a target depends chiefly on the relationship between missile velocity and the amount of protection possessed by the target. Competition between protection strength and missile power is as old as warfare.

A6.1.4.1. One of the most effective penetrators is the shaped charge, which typically has a deep, cone-shaped, metal-lined cavity in the nose of its main explosive charge. When it explodes, the detonating wave is reinforced as it passes from rear to front in the charge. This detonating wave transforms the cone into a molten jet, traveling at nearly 20 times the speed of sound. The high velocity and intense pressure of this jet are so effective that a shaped charge 3 inches in diameter will penetrate 10 to 12 inches of steel.

A6.1.4.2. A second method of overcoming hard targets is through use of a kinetic energy penetrator. Some kinetic energy projectiles make use of an armor piercing cap on the nose, in order to increase the velocity at which the projectile shatters, by decreasing initial impact stress due to inertia. Sometimes the core of a projectile is placed inside a carrier or jacket of low density material such as aluminum. The core is that part of the complete projectile which is intended to perforate the armor. The jacket may be discarded in flight, in which case it is called a "sabot", or the jacket may remain with the projectile until impact, termed "composite rigid type."

A6.1.5. Flame and Incendiary Effects. Firebombs can be highly effective in close air support. Their short, well defined range of effects can interrupt enemy operations without endangering friendly forces. They are also effective against supplies stored in light wooden structures or wooden containers.

A6.1.5.1. Flame and incendiary weapons, however, are often misleading as to the actual physical damage they inflict. Even a relatively small firebomb can provide a spectacular display but often does less damage than might be expected. When a large firebomb splashes a burning gel over an area the size of a football field, it may boil flames a hundred feet into the air. This effect is impressive to the untrained observer, and experienced troops have broken off attacks and fled when exposed to napalm attack. However, soldiers can be trained against this tendency to panic. They can be taught to take cover, put out the fires, and even to brush burning material off their own clothing.

A6.1.5.2. Near misses with firebombs seldom cause damage to vehicles, and the number of troops actually incapacitated by the attacks is usually rather small. Incendiaries of the type that started great fires in Japanese and German cities in World War II projected nonmetallic fragments. They had little penetrating capability. Today's newer munitions have full fragmentation and penetrating capabilities, as well as incendiary devices. However, both types can penetrate and start fires and are highly effective against fuel storage tanks or stacked drums of flammable material of any sort.

A6.2. Nuclear Damage Mechanisms. As with conventional high explosives, a nuclear explosion results from the very rapid release of a large amount of energy within a limited space. High explosive detonation results from chemical reactions, a rearrangement of the atoms present in the explosive. The energy is primarily manifested as blast energy. A nuclear explosion results from a fission process, a fusion process, or a combination of the two. Detonation involves the creation and destruction of atomic nuclei with the release of large quantities of energy in each action. The forces between the protons and neutrons within the atomic nuclei are tremendously greater than those between atoms. Consequently, nuclear energy is of a much higher order of magnitude than conventional (or chemical) energy when equal masses are considered. Because of the much greater amount of energy being released and because of nuclear particles in the detonation being released, there are more and different effects to be considered when dealing with nuclear weapons.

A6.2.1. Types of Bursts. The immediate phenomena associated with a nuclear explosion vary with the spatial location of the burst in relation to the target. The main types of bursts are subsurface, surface, air, high altitude, and exo-atmospheric.

A6.2.1.1. In a subsurface burst, the center of the explosion occurs beneath the surface of the ground or water.

A6.2.1.2. A surface burst is one that occurs either at the actual surface of the land or water or at any height that permits the fireball, at maximum brilliance, to touch the land or water.

A6.2.1.3. In an airburst, the weapon is exploded at such a height above the surface that the fireball does not touch the earth.

A6.2.1.4. A high altitude burst takes place between 100,000 and 400,000 feet.

A6.2.1.5. An exo-atmospheric burst occurs above 400,000 feet.

A6.2.2. Damage Mechanisms. The four basic nuclear weapon damage mechanisms include blast, thermal radiation, nuclear radiation, and electromagnetic phenomena.

A6.2.2.1. Blast. Most of the physical damage in a nuclear explosion results from the blast. Although the phenomena and sequence of events in the blast wave are similar to those from a conventional weapon the greater energy of the nuclear explosion exaggerates the blast effects accordingly.

A6.2.2.1.1. The destructive effects of a blast wave are produced both by overpressure (crushing effect) and dynamic pressure (drag effect). Both effects are expressed in pounds per square inch (PSI). Overpressure, p, is the amount by which the static pressure of the blast wave exceeds normal pressure. Dynamic pressure, q, is associated with the mass motion of air in the blast wave. It is like a strong wind striking a stationary object.

A6.2.2.1.2. An example of a target susceptible to overpressure is a large POL drum. The increased air pressure causes it to collapse. A telephone pole is an example of a target susceptible to dynamic pressure damage. Overpressure would not necessarily hurt it, but dynamic pressure on the order of one PSI would be enough to snap it off.

A6.2.2.1.3. Impulse is one of the primary measures of blast effects in nuclear weapons, as in conventional weapons. Impulse is a measure of the average pressure and the time during which the pressure acts. Damage inflicted on a target by a blast wave is generally a complex function of peak overpressure, peak dynamic pressure, pulse duration, and target structural response characteristics.

A6.2.2.1.4. Nuclear detonations must occur within the earth's atmosphere for any significant blast damage to result because as the altitude of the detonation increases, the blast effects decrease.

A6.2.2.1.5. Mach Stem. When a blast wave strikes a denser medium such as the earth's surface, it is reflected. The reflected wave near the surface travels through a region that is heated and made denser than the ambient atmosphere, by the initial or incident shock front as it passes. Since shock front velocity is greater in heated air, a portion of the reflected shock can, under appropriate conditions, overtake and merge with the incident shock front (initial shock). This forms a single shock front called the Mach stem, which produces higher peak overpressures and lower dynamic pressures at or near the surface.

A6.2.2.1.5.1. A target above the top of the Mach stem receives two shocks, corresponding to the arrival of both incident and reflected waves. A target at or below the top of the Mach stem receives a single shock.

A6.2.2.1.5.2. The reflection process transforms part of the incident dynamic pressure into overpressure. A target below the top of the Mach stem is subjected to a higher over-pressure impulse and a lower dynamic pressure impulse than a target above the top of the Mach stem.

A6.2.2.1.6. Blast wave form and impulses can be affected by a number of conditions, including height of burst and a variety of environmental conditions. Surface conditions, topographic conditions, atmospheric moisture, formation of a precursor (a fast moving thermal layer which moves ahead of the shock wave and disturbs the wave form), and atmospheric pressure must be considered in estimating blast effects.

A6.2.2.1.7. In surface or subsurface bursts, part of the blast will be transmitted into the earth or water. The effects (cratering, shock, etc.) are essentially the same, except in magnitude, as those for nonnuclear weapons, and are therefore not discussed further in this section.

A6.2.2.2. Thermal Radiation. Within a few seconds after the explosion, a typical low altitude nuclear fireball emits about one-third of the weapon yield as infrared, visible, and ultraviolet radiation. This sudden pulse of thermal energy may damage any target that is susceptible to high temperatures. The damage may take many forms, but the most frequent is from fires that start when combustible materials ignite, and injuries to personnel, in the form of burns. Generally, the most serious thermal effects are termed "prompt thermal pulse." Clouds and dust will reduce the transmission of thermal energy, and very little thermal energy is radiated from subsurface bursts. Rarefied air at high altitudes will increase thermal effects from 100,000 feet up to about 140,000 feet; above that the thermal efficiency drops again.

A6.2.2.2.1. X-rays. X-ray energy is radiation from an extremely high temperature source, at frequencies from about 1016 HZ to about 1020 HZ. The rays overlap ultraviolet radiation at the low end of the frequency spectrum and gamma rays at the higher end. X-rays are essentially bursts of energy produced when fast moving free electrons are decelerated through collision, or when electrons in an atom change from one energy level to a lower one. The x-rays exhibit particle-like qualities (for example, in collisions with a particle) and wave-like properties (for example, like visible light waves).

The main effects of x-rays are in their impact upon matter. When x-ray energy strikes an object, it heats rapidly, sending shock waves through the structure and often melting or vaporizing solid material. This shock wave can also damage or weaken the structure by spallation, debonding, or fracturing.

X-rays are rapidly attenuated in nuclear detonations near the surface. In high altitude bursts, the x-rays can travel long distances before they are degraded or absorbed. This makes x-rays the major nuclear effect for high altitude bursts.

A6.2.2.3. Nuclear Radiation Phenomena. One special feature of a nuclear explosion is the emission of gamma rays, neutrons, beta particles, and a small portion of alpha particles.

A6.2.2.3.1. There are essentially three effects of radiation that concern the target analyst: initial radiation (that which occurs within one minute); residual radiation consisting of neutron induced activity in the earth below an air burst; and residual activity consisting of fallout (radioactive residues deposited after a surface burst).

A6.2.2.3.2. The primary effect of these phenomena is on personnel, with penetrating radiation (gamma rays and neutrons) being the most dangerous. Under certain conditions, residual nuclear radiation, from fallout or neutron-induced gamma activity, can deny entry to a bombed area for some period of time after a detonation. Direct nuclear radiation effects on materials and equipment are less significant, except for sensitive detector materials and certain electronic components.

A6.2.2.4. Electromagnetic Phenomena. Because of the importance of this effect, it is considered separately. The two principal phenomena caused by a nuclear detonation affecting electromagnetic propagation (for example, the ability to transmit or receive radio, radar, and optical waveforms) are electromagnetic emissions and atmospheric ionization.

A6.2.2.4.1. The first category consists of EMP, thermal radiation, and emissions from chemical reactions in the atmosphere. These radiations and emissions produce noise throughout the radio and optical spectra.

A6.2.2.4.1.1. Transient Radiation Effects on Electronics (TREE). A special area of interest to the target analyst is the environment created around electronics packages (radio, radar, computers, etc.) by initial nuclear radiation. Weapon burst radiation of interest includes neutrons, gamma rays, x-rays, and, to a much lesser extent, electrons.

A6.2.2.4.1.1.1. Most electronics, especially solid state electronics, are much more sensitive to radiation than other equipment and components such as hydraulic systems, fuel systems, etc. The response of electronics to radiation from a nuclear blast depends not only on the radiation present but on the operating state of the electronics at the time of exposure and on the electronics in the system.

A6.2.2.4.1.1.2. The weapon's radiation environment lasts for a short time. However, its effect on electronics can be either short or long term. For example, it may cause a transfer of charges between materials, a change in current flow, a change in material properties (both chemical and optical properties), a change to component performance, or damage due to heating from radiation.

A6.2.2.4.1.2. Electromagnetic Pulse (EMP) . Whereas TREE refers to the direct effect of nuclear radiation on electronic equipment, EMP refers to its indirect effect. EMP signals are produced when energetic gamma radiation from a nuclear detonation is scattered in radial beams. The effect of EMP comes from the electromagnetic field that is created and propagated through waveforms in the radio and microwave frequency bands. The electrons that are separated from atoms in the air by gamma rays lose energy to surrounding air molecules. The energy lost in these collisions is used to free additional electrons which create further ionization. The net result is a flow of negatively charged electrons moving radially outward from the explosion. This results in an electromagnetic field being radiated from the source. EMP contains only a very small part of the energy produced by a nuclear explosion. However, under certain circumstances EMP can severely disrupt, and sometimes damage, electronic and electrical systems at distances where all other effects are absent. In fact, a detonation above 130,000 feet can produce EMP effects over thousands of square miles on the ground.

A6.2.2.4.2. The second phenomenon, atmospheric ionization, involves alteration of the electrical properties of the atmosphere. Electromagnetic waves propagating through the ionized atmosphere can incur amplitude and phase changes. For detonations below about 50,000 feet, the principal phenomenon affecting electromagnetic propagation is the fireball. While relatively small, it can be intensely ionized for a few tens of seconds. For detonations above 15,000 ft, the fireball can remain intensely ionized for thousands of seconds. A significant fraction of the primary products of the weapon can escape to great distances, and the attendant ionization in the atmosphere can persist for a time ranging from minutes to hours.

Attachment 7

COLLATERAL DAMAGE

A7.1. Introduction. According to DIA's *BDA Quick Guide* (PC-8060-1-96, Feb 96), collateral damage is assessed and reported during the BDA process. Broadly defined, collateral damage is unintentional damage or incidental damage affecting facilities, equipment or personnel occurring as a result of military actions directed against targeted enemy forces or facilities. Such damage can occur to friendly, neutral, and even enemy forces. During Linebacker operations over North Vietnam, for example, some incidental damage occurred from bombs falling outside target areas. Consequently, there was an effort to minimize such collateral damage to civilian facilities in populated regions. Determining collateral damage constraints is a command responsibility. If national command or theater authorities do not predetermine constraint levels for collateral damage, a corps or higher commander will normally be responsible for doing so.

A7.1.1. When a commander is planning strikes near his own forces, there is always some element of risk. Usually, conservative calculations will be prepared (except under emergency conditions) and will lead to minimal risks to friendly forces. Planning may also lead to maximizing collateral damage to enemy facilities near struck targets.

A7.2. Risk. A planner may accept different levels of risk when weapons are to be used near friendly forces. Risk levels are: negligible, moderate, or high (emergency).

A7.2.1. At a negligible risk distance, troops are fairly safe. Such a risk would be considered if nuclear weapons were to be used near friendly troops. Any greater risk would be accepted only when significant advantages could be gained.

A7.2.2. At a moderate risk distance, anticipated damage levels are tolerable, or at worst a minor nuisance. Moderate risk might be considered acceptable in close air support operations.

A7.2.3. At an emergency risk distance, some injuries and fatalities may occur. An emergency risk should be accepted only when absolutely necessary and be exceeded only in extremely rare situations.

A7.3. Safe Distances for Friendly Troops (Conventional Weapons). When computing nonnuclear damage to enemy forces, the effectiveness index lethal area is used. Lethal area is sometimes incorrectly assumed to be a circle, and attempts are made to determine the resulting lethal radius. This cannot be done because the lethal area is not a physical area but instead an integrated probability over the area of effectiveness.

A7.3.1. Some agencies have been provided safe distances using damage criteria developed for determining effectiveness against enemy soldiers, such as the 5-minute casualty criterion. These distances are much larger than the lethal radii discussed above but are still not considered suitable for the safety of friendly troops. For friendly troops, a much more stringent criterion for safety has been established. Effectiveness indices (EI) have been established to provide numerical values to establish the relationship between the target, weapon, and operational factors that influence the weapon's effectiveness. The effective target dimensions (length X width) cannot be used to determine a minimum safe distance from the impact point. Refer to the separate JMEM document *Risk Estimates for Friendly Troops*, 61A1-3-9. This document contains information pertaining to safe distances and provides estimates as to the percentage of casualties that could be expected to friendly troops by the delivery of munitions from friendly aircraft in close air support of those troops. Information is also provided pertaining to the minimum safe distance from bursting munitions that would ensure safety for personnel involved in training exercises, firepower demonstrations, testing and storage of munitions, etc.

A7.4. Safe Distances for Friendly Troops (Nuclear Weapons). Conventional weapons have relatively small effective radii against personnel, but their use in close support of tactical operations still involves some risk to friendly forces. Nuclear weapons increase this risk considerably because of their larger effective radii. Therefore, in the analysis of a potential nuclear target close to friendly troops or to a friendly civilian population, safety risk must be carefully evaluated. The following discussion of troop safety criteria is summarized in table A7.1.

Table A7.1. Troop Safety Criteria for Radius of Safety.

VULNERABILITY CONDITIONAND DEGREE OF RISK	CRITERIA
Unwarned, exposed	
Negligible	Two-thirds of the thermal input (cal/cm2) required to produce first degree burns on bare skin, or 5 rads nuclear radiation.
Moderate	The thermal input (cal/cm2)) required to produce first degree burns on bare skin, or 20 rads.
Emergency	Two-thirds of the thermal input (cal/cm2) required to produce second degree burns on bare skin, or 100 rads.
Warned, exposed	
Negligible	Two-thirds of the thermal input (cal/cm2) required to scorch summer khaki uniforms, or 5 rads.
Moderate	The thermal input (cal/cm2) required to produce first degree burns under summer khaki uniforms, or 20 rads.
Warned, protected	
Negligible	5 rads inside medium tanks, or 3 psi over pressure.
Moderate	20 rads inside medium tanks, or 5 psi overpressure.
Emergency	100 rads inside medium tanks, or 10 psi overpressure.

A7.4.1. When nuclear weapons are considered for employment against close-in targets, troop safety considerations may determine whether or not nuclear weapons will be used. If they are used, troop safety may influence the selection of yield, delivery means, location of the desired ground zero (DGZ), height of burst (HOB), and time of burst, as well as the ground commander's scheme of maneuver. Because of delivery errors and prevailing weather and terrain conditions, calculating the risk to friendly troops involves the use of probabilities and good judgment. It would be desirable to have a 100 percent assurance that no friendly casualties would result from our use of nuclear weapons, but as long as the possibility of delivery error exists, such an assurance is unlikely. As a rule, the commander will want a very high assurance (0.99 probability) that his troops will not be exposed to weapon effects higher than those considered acceptable.

A7.4.2. When nuclear weapons are employed at a considerable distance from friendly troops, safety is a matter of concern from the following viewpoints:

A7.4.2.1. Areas of fallout contamination from surface bursts may preclude or interfere with friendly force use of, or passage through, these areas.

A7.4.2.2. A reasonable margin of safety must be provided for military and civilian populations of friendly and neutral countries in accordance with the area commander's weapons restraint policy.

A7.4.2.3. Temporary dazzle during daylight conditions, loss of night visual adaptation, or retinal burns may handicap friendly forces if they are not warned to protect their eyes at the time of detonation.

A7.4.3. In addition to degrees of risk, one of the following three conditions of personnel vulnerability can be expected at the time of burst: unwarned, exposed; warned, exposed; or warned, protected.

A7.4.3.1. Unwarned, exposed troops are assumed to be standing in the open at burst time but to have dropped to a prone position by the time the blast wave arrives. They are expected to have areas of bare skin exposed to direct thermal radiation, and some personnel may suffer temporary dazzle. For example, this condition can be expected in an offensive situation where the majority of the attacking infantry are in the open and cannot be warned of the burst.

A7.4.3.2. Warned, exposed troops are assumed to be prone on open ground, with all skin areas covered, and with overall thermal protection equal to that provided by a two-layer summer uniform. For example, such a condition is expected to prevail when a nuclear weapon is detonated over a target at a prearranged time during an attack when troops are expecting the burst but do not have time to prepare foxholes.

A7.4.3.3. Warned, protected troops are assumed to be "buttoned up" in tanks or crouching in foxholes with improvised overhead thermal shielding. For example, such a condition is expected to prevail when nuclear weapons are used in support of an attack by our armored forces.

A7.4.4. The predicted ranges for thermal radiation and initial nuclear radiation are provided in the DIA manual, *Physical Vulnerability Handbook--Nuclear Weapons,* AP-550-1-2-INT.

A7.4.5. Troop safety distance calculations are usually based on a high assurance of not exceeding a certain criterion for safety. Aircraft and guided missile-delivered weapons require a horizontal buffer distance (d) of 2 CEP for a very, very high safety assurance (0.99~ for a straight line troop disposition; 2.3 CEP for a very high assurance (0.95) for either a half-circular or a circular troop disposition.

A7.4.6. A weapon set to burst at a fallout-safe height of burst has a 0.50 probability of being below the "selected" burst height on detonation. Therefore, to achieve an assurance of no fallout (of military significance), a vertical buffer distance must be added to the HOB. These distances can be obtained from figures in the *Physical Vulnerability Handbook--Nuclear Weapons,* AP-550-1-2-INT.

A7.4.7. For a very high assurance that friendly troops will not be exposed to any weapons effects greater than those considered acceptable, add 2 CEP to the radius of safety (RS) to obtain the minimum safe distance (MSD), and add 3.5 Probable Error in Height (peh) to the fallout-safe height of burst (HOBfS).

A7.5. Macro Models for Computing Collateral Damage . Standard models are available in conventional and nuclear weaponeering manuals for use in determining expected collateral damage involving one or a few sorties and one or a few target elements. The planner can use these models as they stand, based on "average" estimates, or can apply conservative factors as outlined earlier in the sections on safe distances. For detailed target analysis collateral damage avoidance tables for each weapon system and yield can be obtained in FM 101-31-2/AFP 200-31, Volume II, *Nuclear Weapons Employment Effects Data*.

A7.5.1. These data can be aggregated into larger models providing insight into large scale situations involving thousands of targets and weapons. One such model is TANDEM (Tactical Nuclear Damage Evaluation Model), developed by the RAND Corporation. This program takes target data such as location and the probability of damage to targets and population centers, vulnerability numbers, interrelation maps, weapon assignments (yield, height of burst, CEP, etc.) and other factors as inputs. TANDEM is analyzed, and outputs may indicate target damage, collateral damage, and bonus damage.

A7.5.2. A number of other programs are available or can be modified to compute large scale collateral damage. Nonnuclear weaponeering programs provided by the JMEM for programmable calculators provide an "offset" capability to determine collateral damage. In these programs, the range offset and the deflection offset can be used to represent distances from aimpoint for facilities that may be subjected to collateral damage. These programs can be modified to provide numerous computations.

Attachment 8

GEOSPATIAL INFORMATION AND PRODUCTS

A8.1. Geospatial Information. Any information that has associated with it some geographical and temporal reference (includes what is referred to as Mapping, Charting, and Geodesy; Imagery; and Imagery Intelligence). Data defining characteristics, properties, and location of physical and cultural phenomenon associated with the earth's natural and man-made environment (information generally found on maps and charts, spatially controlled imagery).

A8.1.1. Global Geospatial Information & Services (GGI&S). Worldwide, accurate, current, spatially co-referenced, attributed feature information about the earth arranged in a coherent structure to support measurement, mapping, monitoring, modeling, terrain elevation, and spatial reasoning applications.

A8.1.2. GGI&S Community. Refers to the combined efforts of any and all U.S. organizations dealing with the planning, collection, production, dissemination, ordering, or exploitation of GGI&S for the purposes of supporting the JCS, Unified Commands, Services, and agencies.

A8.2. Aeronautical Products. A specialized representation of mapped features of the Earth, or some part of it, produced to show selected terrain, cultural, and hydrographic features, and supplemental information required for air navigation, pilotage, or for planning air operations.

A8.2.1. Global Navigation and Planning Chart (GNC). Worldwide small-scale (1:5,000,000) aeronautical chart series. Used for high-altitude, high-speed, extended long-range navigation and flight planning.

A8.2.2. Jet Navigation Chart (JNC). A worldwide small-scale(1:2,000,000) aeronautical chart series. Used for high-altitude, high-speed, long-range navigation and planning and as a source for navigational filmstrips.

A8.2.3. Operational Navigation Chart (ONC). The ONC is the standard worldwide small-scale (1:1,000,000) aeronautical chart series, and contains cartographic data with an aeronautical overprint depicting obstructions, aerodromes, special use airspace, navigational aides, Maximum Elevation Figures (MEFs), and related data. Because of scale, some features, including obstructions, are generalized in developed regions. A Military Grid is overprinted for interoperability, especially in regions of no TPC coverage. Designed for medium altitude high-speed visual and radar navigation. Also used for mission planning/analysis and intelligence briefings, and as source for navigational filmstrips, special purpose, and cockpit/visual display products.

A8.2.4. Tactical Pilotage Chart (TPC). The TPC is the standard worldwide medium-scale aeronautical chart series (1:500,000). TPCs provide essential cartographic data appropriate to scale, and are overprinted with stable aeronautical information such as obstructions, aerodromes, special use airspace, navigational aids, MEFs, and related data. Cartographic data with aeronautical overprint depicting obstructions, aerodromes, special use airspace, navigational aids and related data. Because of scale, some features, including obstructions, are generalized in developed regions. A Military Grid is overprinted for interoperability. Designed for very low-altitude through medium-altitude high-speed visual and radar navigation. TPCs are also used for mission planning/analysis and intelligence briefings, and are source for navigational filmstrips, special purpose, and cockpit/visual display products.

A8.2.5. Joint Operations Graphic-Air (JOG-A) Chart. The standard DoD medium scale chart, 1:250,000 scale. The JOG-A is a standard series modified for aeronautical use. The JOG-A displays topographic data such as: relief, drainage, vegetation, populated places, cultural features, coastal hydrography, aeronautical overprint depicting obstructions, aerodromes, special use airspace, navigational aids and related data. The JOG-A supports tactical and other air activities including low altitude visual navigation.

A8.2.6. Chart Updating Manual (CHUM). A semi-annual publication containing a complete list of published aeronautical charts and a list of known corrections, if any, to each chart. A CHUM supplement is published monthly during the five months between issues of the complete CHUM and contains a cumulative listing of additional corrections since the previous CHUM was published. The CHUM is used to manual amendment of selected aeronautical charts with update or corrected information pertaining to safety of navigation. The contents of the CHUM include chart series, chart name, edition number, aeronautical information, current date and corrections for the available charts in a given series. The CHUM lists only the known chart discrepancies that meet the CHUM criteria and which are received on or before the published cut-off date. The chart corrections found in the CHUM are retained in the CHUM or CHUM Supplements until the chart in question is obsolete or replaced by a new edition.

A8.2.7. Electronic CHUM (ECHUM). ECHUM will contain the same information as the CHUM but the information is accessible by dial-up capability/electronically accessible.

A8.2.8. Flight Information Publications (FLIP). Provides aeronautical information required by aircrews in flight and is designed for worldwide use in conjunction with the Enroute Supplements. A series of textual and graphic products aligned to the three phases of Flight Planning (Planning Document), Enroute, (Flight Information Handbook, Enroute Supplement, Enroute Charts, Terminal Area Charts, Area Arrival Chart Depicting Terrain Data), and Terminal (Terminal Instrument Approach Procedures, Standard Instrument Departure Procedures). These products are geographically grouped into seven regions. They are published in 28-day cycles to coincide with internationally established effective dates. Designed primarily for use in instrument flight conditions and for planning. Product is critical to the safety of flight.

A8.3. Topographic Products.

A8.3.1. City Graphic. Large-scale lithographic map of populated places and environs portraying streets and through-route information. Features include important buildings, airfields, military installations, industrial complexes, embassies, government buildings, hospitals, schools, utilities, and places of worship. Militarily significant relief is shown. A guide to numbered buildings and an index to street names are provided in the margin. Used to support administrative and tactical planning and operations in urban areas.

A8.3.2. Joint Operations Graphic - Ground (JOG-G). The standard DoD 1:250,000 scale medium scale map. This series is produced by several nations using the same product specification. The JOG-G displays topographic data such as: relief, drainage, vegetation, populated places, cultural features and coastal hydrography. The JOG-G supports ground forces employed in joint air/ground operations and is used primarily for tactical and logistical planning and search and rescue.

A8.3.3. Topographic Line Map (TLM). A lithographic map that portrays topographic and cultural features (1:100,000 and 1:50,000). Feature portrayal includes relief, drainage, vegetation, populated places, cultural features, roads and railroads. The map is a true representation of terrain detail. Primarily used by land and air forces in support of ground operations for planning, tactical operations, terrain study, and target acquisition.

A8.4. Digital Products.

Composite Data	Geographic object composed of a raster product format frame (RPF) with vector product format (VPF) features located within the boundaries and text product format paragraphs whose indexes fall within the boundaries.
Raster Data	A representation of Geospatial data characterized by a matrix of evenly spaced rows and columns of data points. These data points (Pixels) typically represent some value at that point, while the position within the columns and rows determines the geographic position. Raster data structures are typically used to record scanned maps and charts, image data, or grided data.
Vector Data	Data which represents each cartographic feature by an entity description (feature code) and a spatial extent (geographic position). Geographic position may be two-dimensional (horizontal position only) or three-dimensional (including elevation). Features are categorized as point, line, or area features. The position of a point feature is described by a string of coordinated of points lying along the line, while the extent of an area feature is described by treating its boundary as a line feature. Vector data may be stored in a sequential, a chain node, or a topological data structure.

A8.4.1. ARC Digitized Raster Graphics (ADRG). ADRG is a standard NIMA digital product designed to support applications that require a raster map background display. Paper maps and charts are converted into digital format by raster scanning and transforming the data into the Equal Arc-Second Raster Chart/Map (ARC system frame of reference). Data collected from a single map/chart series and scale are maintained as a worldwide seamless data base of raster graphic data, with each pixel having a distinct geographic location. NIMA has produced more than 4,500 CD-ROM titles with worldwide coverage of GNC, JNC, ONC, and TPC products. Extensive coverage of JOGs is provided, and some coverage is provided of TLM 100s and TLM 50s, for high-interest areas.

A8.4.2. ARC Digital Raster Imagery (ADRI). ADRI is digital imagery produced to support various Air Force weapons and mission support systems. ADRI is currently produced from panchromatic SPOT commercial imagery which is orthorectified using NIMA DTED or other elevation data to remove terrain displacement and other distortions which may be present within the original source imagery. ADRI can be used as a digital map substitute, as a background display for command and control systems, as controlled imagery for draping during terrain visualization, and as a metric foundation for anchoring other spatial data in geographic information systems or to anchor more current imagery for interpretation. A joint requirement has been recognize, and is being documented, for abroad-area CIB.

A8.4.3. Compressed ARC Digitized Raster Graphics (CADRG). A Joint Services' standard map background product. CADRG will be produced in multiple scales in support of systems with map background display, coordinates selection, and perspective view generation capabilities. CADRG is a compressed version of ADRG (nominal compression of 55:1 over ADRG). CADRG is RPF and NITF compliant.

A8.4.4. Controlled Image Base (CIB). CIB is unclassified digital imagery, produced to support mission planning and command, control, communications, and intelligence systems. CIB will be used as a map substitute for emergencies and crises in the event that maps do not exist or are outdated. CIB is panchromatic digital imagery and is produced from SPOT commercial imagery that has been orthonormalized using NIMA DTED. CIB is RPF and NITF compliant.

A8.4.5. Digital Feature Analysis Data (DFAD). DFAD is a standard NIMA product that supports radar return simulation, navigation and terrain obstruction studies. When combined with DTED, DFAD provides an off-line data base for use by weapon system flight simulators and other types of simulation, such as line of sight, obstruction, and perspective view development. It portrays major natural and man-made features on the Earth's surface; the features and associated attributes of which are generally of radar reflectance significance. Content is derived from both cartographic and photogrammetric source material.

A8.4.6. Digital Chart of the World. A comprehensive 1:1,000,000 scale vector base map of the world. It consist of cartographic, attribute and textual data stored on CD-ROM. The primary source for the data base is the NIMA's ONC series. This is the largest scale unclassified map series in existence that provides consistent, continuous global coverage of essential base map features. The data base contains more than 1,500 megabytes of vector data and is organized into 17 thematic layers. The data includes major road and rail networks, major hydrologic drainage systems, major utility networks, all major airports, elevation contours, coastlines international boundaries and populated places. The DCW also has an index of geographic names to aid in locating areas of interest.

A8.4.7. Digital Point Positioning Data Base (DPPDB). A new digital product produced by NIMA, replacing the hard copy Point Positioning Data Base product. The DPPDB provides the warfighter with a deployable data base, in a computer workstation environment from which latitude, longitude, and elevation can be quickly and accurately derived on digital image exploitation systems.

A8.4.8. Digital Terrain Elevation Data (DTED). DTED was originally developed in the 1970s to support aircraft radar simulation and prediction. DTED supports many applications, including line-of-sight analyses, terrain profiling, 3-D terrain visualization, mission planning/rehearsal, and modeling and simulation. DTED is a standard NIMA product that provides medium resolution, quantitative data in a digital format for military system applications that require terrain elevation. DTED Level 1 has a post spacing of 3 seconds or 100 meters. DTED Level 2 has a post spacing of 1 second or 30 meters.

A8.4.9. Vector Smart Map (VMAP). A collection of data bases that provide vector-based geo-spatial data at low, medium, or high resolution. These data are separated into nine thematic layers and are topologically structured. This product is designed to support geographical information system analysis and can be used for various situation/map background displays. VMAP Level 0 contains the low-resolution feature and attribute content of ONC. VMAP Level 1 will contain the feature and attribute content similar to JOG scale. VMAP level 2 will have the feature and attribute content similar to TLM scale. VMAP is VPF and NITF compliant.

A8.5. Documents. The NIMA Catalogs contain the stock numbers needed to order products.

A8.5.1. Part 1 Aerospace Products, Volume I, Aeronautical Charts, Flight Infor mation Publications and Related Products (CATP1V01). Provides coverage, product availability, and ordering procedures for aeronautical navigation and planning charts, Flight Information Publication (FLIP), Navigational Filmstrips, and related products.

A8.5.1.1. **Semiannual Bulletin Digest for Aeronautical Products (CATP1UBD).** Used to update Part 1.

A8.5.2. Part 3, Topographic Products, Volume I, All Scales (CATP3V01U). This catalog identifies the topographic products available from NIMA.

A8.5.2.1. Semiannual Bulletin Digest for Topographic Products (CATP3V01UBD). Used to update Part 3.

A8.5.3. Part 3, Topographic Products, Volume II, Classified Topographic Maps and Related Products (SECRET) (CATP3V02C). This catalog identifies the classified topographic products available from NIMA.

A8.5.3.1. Semiannual Bulletin Digest for Classified Topographic Maps and Related Products (CONFIDENTIAL) (CATP3V02CBD). Used to update Part 3, Vol II.

A8.5.4. Part 4, Target Material Products, Volume I, Air Target Materials Charts (CONFIDENTIAL) (CATP4V01). A semiannual publication listing air target materials.

A8.5.5. Part 7, Digital Data Products, Volume I, Terrain, Feature and World Vec tor Shoreline Data (CATP7V01). Provides information on the availability of DTED and DFAD.

A8.5.6. Part 7, Digital Data Products, Volume III, ARC Digitized Raster Graphics (CATP7V03). Contains aeronautical and topographic ADRGs that are portrayed graphically and listed by stock number.

A8.5.7. Consolidated Air Target Materials Notices/Target Materials Bulletin, Volume I (SECRET) (CATP4CATMNV1). Contains informational articles and ATM change notices in textual form. Provides an inventory of previously published and new ATM changes to Series 200 Air Target Charts and Series 1501 Radar Joint Operations Graphics.

A8.5.8. Consolidated Air Target Materials Notices/Target Materials Bulletin, Volume II (SECRET) (CATP4CATMNV2). Contains ATM changes notices in graphic form. Provides an inventory of previously published and new ATM changes to Series 200 Air Target Charts and Series 1501 Radar Joint Operations Graphics.

A8.5.9. NIMA Chart Updating Manual (CATP1CHUM). Produced semi-annually, contains a complete list of published charts for each series and a list of known corrections, if any, to each chart.

A8.5.10. NIMA Chart Updating Manual Supplement (CATP1CHUMSUP). Published monthly during the five months between issues of the complete CHUM and contain a cumulative listing of additional corrections.

A8.5.11. NIMA Interim Catalog of Controlled Image Base (CIB) Products (CATP7V04). This catalog contains CIB graphics along with text pages showing stock numbers.

A8.6. Software. NIMA produces general purpose utility software to standardize the examination of MC&G digital data.

A8.6.1. DEW_Drop DPPDB Exploitation. DEW_Drop allows the user to quickly and accurately view DPPDB imagery and to perform point mensuration.

A8.6.2. Mapping, Charting, and Geodesy Utility Software Environment (MUSE). MUSE represents an effort to develop a standard suite of software to access NIMA digital data sets and work with standard NIMA datum transformations and coordinate conversions. The MUSE objectives are to provide multiple system platform interpretability (MS-DOS, Windows, Macintosh, and UNIX), access to standard NIMA products, NIMA standard datum transformations and coordinate conversions, and applications demonstrating NIMA digital data synergy and exploitation. The standard NIMA spatial (raster) products that can be accessed are ADRG, ADRI, CADRG, CIB, and DTED. The standard NIMA VPF products that can be accessed are DCW and VMAP. MUSE applications are provided to demonstrate raster/vector map construction and manipulation, raster/elevation draping and perspective views, and raster elevation line of sight analysis.

A8.6.3. Vector Product Format VIEW (VPFVIEW). The VPFVIEW software designed to access any database implemented in VPF and query data contained in any VPF data base but its analytical capability is limited to constructing views and themes. It enable you to select data for display by geographic region as well as type.

Datum	A math model of the Earth's shape used as a basic reference to calculate position coordinates, heights, and distances. The datum is the origin or point of reference.
WGS 84	World Geodetic System 1984 is the official DoD positional reference system. WGS 84 is a unified earth-centered model of the globe based on improved geometric, geodetic, and gravity information. WGS 84 relates positions on the other datums to a single interoperable standard.